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THE INDIAN EMPIRE

VOL. I

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TO HIS MOST GRACIOUS MAJESTY

KING EDWARD VII

EMPEROR OF INDIA

THIS WORK IS BY HIS ROYAL PERMISSION

DEDICATED

GENERAL PREFACE

THE first edition of *The Imperial Gazetteer of India* was published in nine volumes in 1881. A second edition, augmented to fourteen volumes, was issued in the years 1885–7. A revised form of the article on India, greatly enlarged and with statistics brought up to date, appeared as an independent volume in 1893, under the title of 'The Indian Empire: Its Peoples, History, and Products.' All of these were edited by the late Sir William Wilson Hunter, K.C.S.I., who formed the original plan of the work as far back as 1869, when he was first entrusted with the duty of organizing a statistical survey of the country, and who wrote most of 'The Indian Empire' in its final form with his own hand. His untimely death in 1900 has deprived the present edition of the advantages of his ripe experience and literary skill.

The second edition having for some time passed out of print, it was resolved by the Government of India that a new edition should be prepared in connexion with the Census of 1901. The changes, however, that have been introduced, both in the general scheme and in the methods of compilation, may justify its being considered as a new work rather than a new edition. The bulk will be raised from fourteen to twenty-six volumes, including a companion Atlas; and the single volume of 'The Indian Empire' has been expanded into four volumes, entitled respectively 'Descriptive,' 'Historical,' 'Economic,' and 'Administrative.' Moreover, while the main work will be arranged as before in alphabetical order, it is intended to issue in India, for official and local use, a parallel series in which the several articles relating to each Province or large group of States will be collected together in

separate volumes. No less considerable are the changes that have been made in methods of compilation. Apart from the Historical volume and a few other chapters of 'The Indian Empire,' the whole of the work has been written by officials in India under orders of the Indian Government; and every page has been submitted to the criticism of the several Administrations or Departments concerned.

The task of editorial supervision has been shared between India and England. In India the first outlines were drawn up in consultation with Sir Herbert Risley, K.C.I.E., at the time when he was Census Commissioner. On his nomination to be Secretary in the Home Department, Mr. W. S. Meyer, C.I.E., was appointed editor for India; and to him are due the detailed regulations under which the greater part of the work has been executed, the general scheme of the Atlas, and the primary revision of most of the chapters dealing with India as a whole. When he, in turn, was promoted to be Secretary in the Finance Department, he was succeeded by Mr. R. Burn, who has carried out the primary revision of most of the other volumes, and otherwise completed the work that had to be done in India.[1] The editor in England throughout has been Mr. J. S. Cotton, who was closely associated with Sir W. W. Hunter in both the former editions. On him, in subordination to a committee appointed by the Secretary of State, has rested the responsibility for the final form of the work, and the duty of seeing the whole through the press.

The volumes of 'The Indian Empire' have been entirely rewritten, with the exception of the history of the British period, where the personal impress of Sir W. W. Hunter's knowledge and style is preserved. The principle adopted was to entrust each subject to an author best qualified to deal with it either by special study or official experience. The names of the authors are usually appended to their chapters; but in other cases the text, as finally approved, can be

[1] The Indian editors desire to acknowledge specially the services of Mr. V. Krishna Menon, their head clerk.

regarded only as a composite production based largely upon their contributions, and their names are then recorded elsewhere. This course has been found necessary in order to maintain the character of official authority that attaches to the work.

The articles that make up the body of the *Gazetteer* have likewise been rewritten, for the most part by officials who had already acquired local experience as Census Superintendents of their Provinces or States in 1901. A list of their names will be found prefixed to the first volume of the *Gazetteer* proper. As in the previous editions, the articles are based on materials collected by District officers and officials of Native States, supplemented by special contributions from experts. More detailed acknowledgements will be found in the prefaces to the volumes of the *Provincial Gazetteers*. It may here be mentioned that, since the last edition was compiled, Upper Burma and Baluchistān have both been included within the Empire, and two new Provinces have been constituted, while much more accurate information is now available for the Native States generally.

To come to details. Comparative statistics are usually given for the three Census years, 1881, 1891, and 1901; but in most cases later figures for 1903-4 have been added. The most recent administrative changes have been incorporated or referred to in footnotes, so far as possible. No novelties have been introduced in the way of spelling, the usage now generally adopted in India having been followed, even where this usage cannot be considered satisfactory or consistent. The only important change is the substitution of the mark of length (¯) for the accent (′) over long vowels. Some hints for guidance in pronunciation are given in an Introductory Note, prefixed to each volume. Another Introductory Note supplies a brief explanation of the monetary system and the weights and measures used in India, for it has not been found practicable to convert these uniformly into their English equivalents.

In the present volume, being the Descriptive volume of 'The Indian Empire,' chapters i, ii, iv, v, vii, viii, ix, and x

have been written by the authors whose names are subscribed to them. Dr. Blanford died before he was able to revise his proofs. Of the other chapters, that on Meteorology is based upon materials contributed by Sir John Eliot, K.C.I.E., and that on Ethnology and Caste has been abridged from Sir H. Risley's chapter in the *Report on the Census of India for* 1901. The Index has been compiled by Mr. J. W. Browne.

INTRODUCTORY NOTES

NOTES ON TRANSLITERATION

Vowel-Sounds

a has the sound of *a* in 'woman.'
ā has the sound of *a* in 'father.'
e has the vowel-sound in 'grey.'
i has the sound of *i* in 'pin.'
ī has the sound of *i* in 'police.'
o has the sound of *o* in 'bone.'
u has the sound of *u* in 'bull.'
ū has the sound of *u* in 'flute.'
ai has the vowel-sound in 'mine.'
au has the vowel-sound in 'house.'

It should be stated that no attempt has been made to distinguish between the long and short sounds of *e* and *o* in the Dravidian languages, which possess the vowel-sounds in 'bet' and 'hot' in addition to those given above. Nor has it been thought necessary to mark vowels as long in cases where mistakes in pronunciation were not likely to be made.

Consonants

Most Indian languages have different forms for a number of consonants, such as *d*, *t*, *r*, &c., marked in scientific works by the use of dots or italics. As the European ear distinguishes these with difficulty in ordinary pronunciation, it has been considered undesirable to embarrass the reader with them; and only two notes are required. In the first place, the Arabic *k*, a strong guttural, has been represented by *k* instead of *q*, which is often used. Secondly, it should be remarked that aspirated consonants are common; and, in particular, *dh* and *th* (except in Burma) never have the sound of *th* in 'this' or 'thin,' but should be pronounced as in 'woodhouse' and 'boathook.'

Burmese Words

Burmese and some of the languages on the frontier of China have the following special sounds:—

aw has the vowel-sound in 'law.'
ö and ü are pronounced as in German.
gy is pronounced almost like *j* in 'jewel.'
ky is pronounced almost like *ch* in 'church.'
th is pronounced in some cases as in 'this,' in some cases as in 'thin.'
w after a consonant has the force of *uw*. Thus, *ywa* and *pwe* are disyllables, pronounced as if written *yuwa* and *puwe*.

It should also be noted that, whereas in Indian words the accent or stress is distributed almost equally on each syllable, in Burmese there is a tendency to throw special stress on the last syllable.

General

The names of some places—e.g. Calcutta, Bombay, Lucknow, Cawnpore—have obtained a popular fixity of spelling, while special forms have been officially prescribed for others. Names of persons are often spelt and pronounced differently in different parts of India; but the variations have been made as few as possible by assimilating forms almost alike, especially where a particular spelling has been generally adopted in English books.

Notes on Money, Prices, Weights and Measures

As the currency of India is based upon the rupee, all statements with regard to money throughout the *Gazetteer* have necessarily been expressed in rupees, nor has it been found possible to add generally a conversion into sterling. Down to about 1873 the gold value of the rupee (containing 165 grains of pure silver) was approximately equal to 2*s*., or one-tenth of a £; and for that period it is easy to convert rupees into sterling by striking off the final cipher (Rs. 1,000 =£100). But after 1873, owing to the depreciation of silver as compared with gold throughout the world, there came a serious and progressive fall in the exchange, until at one time the gold value of the rupee dropped as low as 1*s*. In order to provide a remedy for the heavy loss caused to the Government of India in respect of its gold payments to be made in England, and also to relieve foreign trade and finance from the inconvenience due to constant and unforeseen fluctuations in exchange, it was resolved in 1893 to close the mints to the free coinage of silver, and thus force up the value of the rupee by restricting the circulation. The intention was to raise

the exchange value of the rupee to 1*s.* 4*d.*, and then introduce a gold standard (though not necessarily a gold currency) at the rate of Rs. 15 = £1. This policy has been completely successful. From 1899 onwards the value of the rupee has been maintained, with insignificant fluctuations, at the proposed rate of 1*s.* 4*d.*; and consequently since that date three rupees have been equivalent to two rupees before 1873. For the intermediate period, between 1873 and 1899, it is manifestly impossible to adopt any fixed sterling value for a constantly changing rupee. But since 1899, if it is desired to convert rupees into sterling, not only must the final cipher be struck off (as before 1873), but also one-third must be subtracted from the result. Thus Rs. 1,000 = £100 $-\frac{1}{3}$ = (about) £67.

Another matter in connexion with the expression of money statements in terms of rupees requires to be explained. The method of numerical notation in India differs from that which prevails throughout Europe. Large numbers are not punctuated in hundreds of thousands and millions, but in lakhs and crores. A lakh is one hundred thousand (written out as 1,00,000), and a crore is one hundred lakhs or ten millions (written out as 1,00,00,000). Consequently, according to the exchange value of the rupee, a lakh of rupees (Rs. 1,00,000) may be read as the equivalent of £10,000 before 1873, and as the equivalent of (about) £6,667 after 1899; while a crore of rupees (Rs. 1,00,00,000) may similarly be read as the equivalent of £1,000,000 before 1873, and as the equivalent of (about) £666,667 after 1899.

Finally, it should be mentioned that the rupee is divided into 16 annas, a fraction commonly used for many purposes by both natives and Europeans. The anna was formerly reckoned as $1\frac{1}{2}$*d.*; it may now be considered as exactly corresponding to 1*d.* The anna is again subdivided into 12 pies.

The various systems of weights used in India combine uniformity of scale with immense variations in the weight of units. The scale used generally throughout Northern India, and less commonly in Madras and Bombay, may be thus expressed: one maund = 40 seers; one seer = 16 chittaks or 80 tolas. The actual weight of a seer varies greatly from District to District, and even from village to village; but in the standard system the tola is 180 grains Troy (the exact weight of the rupee), and the seer thus weighs 2·057 lb., and the maund 82·28 lb. This standard is used in official reports and throughout the *Gazetteer*.

For calculating retail prices, the universal custom in India is to express them in terms of seers to the rupee. Thus, when prices change, what varies is not the amount of money to be paid for the

same quantity, but the quantity to be obtained for the same amount of money. In other words, prices in India are quantity prices, not money prices. When the figure of quantity goes up, this of course means that the price has gone down, which is at first sight perplexing to an English reader. It may, however, be mentioned that quantity prices are not altogether unknown in England, especially at small shops, where pennyworths of many groceries can be bought. Eggs, likewise, are commonly sold at a varying number for the shilling. If it be desired to convert quantity prices from Indian into English denominations without having recourse to money prices (which would often be misleading), the following scale may be adopted—based upon the assumptions that a seer is exactly 2 lb., and that the value of the rupee remains constant at 1*s.* 4*d.*: 1 seer per rupee = (about) 3 lb. for 2*s.*; 2 seers per rupee = (about) 6 lb. for 2*s.*; and so on.

The name of the unit for square measurement in India generally is the *bīgha*, which varies greatly in different parts of the country. But areas have always been expressed throughout the *Gazetteer* either in square miles or in acres.

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THE INDIAN EMPIRE

VOLUME I

DESCRIPTIVE

CHAPTER I

PHYSICAL ASPECTS

No one who travels through the length and breadth of the continent of India can fail to be struck with the extraordinary variety of its physical aspects. In the north rise magnificent mountain altitudes, bound by snowfield and glacier in eternal solitude. At their feet lie smooth wide spaces of depressed river basins; either sandy, dry, and sun-scorched, or cultivated and water-logged under a steamy moisture-laden atmosphere. To the south spreads a great central plateau, where indigenous forest still hides the scattered clans of aboriginal tribes; flanked on the west by the broken crags and castellated outlines of the ridges overlooking the Indian Ocean, and on the south by gentle, smooth, rounded slopes of green upland. Something at least of the throes and convulsions of nature which accompanied the birth of this changeful land is recorded in the physical aspect of the mountains and valleys which traverse it; and an appeal to the evidence of the rocks is answered by the story of its evolution.

Extreme variety of physical aspects.

Oldest of all the physical features which intersect the continent is the range of mountains known as the Arāvallis, which strikes across the Peninsula from north-east to south-west, overlooking the sandy wastes of Rājputāna. The Arāvallis are but the depressed and degraded relics of a far more prominent mountain system, which stood, in Palaeozoic times, on the edge of the Rājputāna Sea. The disintegrated rocks which once formed part of the Arāvallis are now spread out in wide red-sandstone plains to the east. There Vindhyan and Cuddapah sedimentary deposits cover the ancient core of

India in ancient geological times.

gneiss and granite which formed the bed-rock when, in the earliest beginnings of which geological science can take account, the Peninsula extended from the Arāvallis to the present east coast. There is no evidence of any great change in the outline of the east coast of India since Palaeozoic times. No fossils are found in the marine deposits of Secondary and Tertiary age in the interior of the continent. No life, no slow movement of creeping things, disturbed the awful silence of that weird landscape of primaeval days, when India was represented by the central plateau and its northern fringe of Arāvalli mountains. This, then, was the first stage of evolution. Never since the Palaeozoic era has this part of the continent been depressed beneath the sea. Over the extra-peninsular area, north of it and west, where now exist the regions of Baluchistān, Afghānistān, the valley of the Indus, and Rājputāna, with the great extension of the North-western Himālayas, the tides of a wide and shallow sea ebbed and flowed. Then, in Tertiary times, followed the slow formation of the Gondwāna beds, the gradual spreading out of sandy deposits, and the outlining of the leading features of Indian topography as we see them now. After the Palaeozoic era, and during the secondary stage of evolution, when India was probably connected with Africa by dry land and ocean currents swept from the Persian Gulf to the Arāvallis, the rock area extended over Assam and the Eastern Himālayas, while Burma, the North-western Himālayas, and the uplands beyond the Indus were still submarine, or undergoing alternations of elevation and depression.

At the close of the Cretaceous period, the infinitely gentle process of sedimentary deposit and the dead repose of the geological world were rudely shaken. Then ensued a series of volcanic cataclysms, such as the eastern world has probably never seen since. Two hundred thousand square miles of India's surface were covered with lava and volcanic deposits to a depth of thousands of feet, and the Deccan landscape was shaped to its present outlines. As the period of volcanic activity ceased, there commenced in the far north the throes of an upheaval, which has gradually (acting through inconceivable ages) raised marine limestone of Nummulitic age to a height of 20,000 feet above the sea, and resulted in the most stupendous mountain system of the world. The North-western Himālayas, Tibet, and Burma were gradually upraised and fashioned during this epoch; but there is evidence that Burma is a much more recent

geographical feature than the North-western Himālayas, which were formidable mountains even in Pliocene ages, and were much as they are now in the days when the Siwālik fauna browsed in sub-Himālayan forests. The period of earth-movements appears to have culminated in the Pliocene period, but never to have subsided; for these movements are even now perceptibly re-shaping the ends of Indian physiography. The sea, which once flooded the area of the western frontier hills, Tibet, and Burma, was driven back; and the marine rock deposits of the west were crushed and folded as we see them now, where their serried battalions of ridges, line upon line, present a forbidding front to the Indus valley. The formation of a great depression was more or less coincident with the upheaval of the mountains. At first it was a wide and deep partition between the Himālayas and the Peninsula, which the collected alluvium of ages gradually filled as it was brought by the action of the great river of the west, the Indus, from the whole Himālayan system. A comparatively recent development of these movements between Assam and the Rājmahāl hills has formed the eastern or Gangetic depression; and the final dividing of the waters of these two great river-systems (Indus and Ganges) may have occurred almost within historic time. No further change can now take place; for the rivers have marked out their own courses and adjusted their gradients to permanent beds.

It is doubtful what happened within the limits of the Peninsula while these great movements and shiftings of level were in progress beyond it. Probably it was then that the connecting link between India and Africa was severed, and that the western continent, indicated by the coral archipelagoes of the Maldive and Laccadive islands, was submerged; but geological science inclines to the opinion that the elevation of the Western Ghāts was comparatively recent. The steep-sided, narrow valleys of the Ghāts, where the streams are still cutting their way back at their sources and gradually working their beds down to a permanent level, appear to be in the same stage of development as those of the extra-peninsular hills. One result of this process of evolution has been that nearly all the great rivers of Southern India take their rise in the western hills, and flow across the continent to the Bay of Bengal. The Narbadā and the Tāpti alone cut their way in deep channels westward; and there are indications farther south of a third great river which may

promise, as well as the narrow pathways for the commerce of centuries long past. If, in a future of railway developments and a rush of motor traffic, once again the land approaches to India rival those of the sea, then will some of these again become the highways of the eastern world, and we shall take our tickets in London for Herāt, and change at Kandahār for Kābul or Karāchi.

There are other tracks and byways of the mountains through which from time to time men have made their perilous way to the plains of India. Routes exist by Leh and Kashmīr, or by the gorges of the Sutlej from Tibet, or by the passes beyond Gilgit from the Pāmirs, or by those of Sikkim from Lhāsa; but these are not the highways of a multitude. No rush of invasion from the west, or of Central Asiatic migration from the north, ever swept through them southwards, and none ever will. The stupendous dispositions of nature still overmatch the beautiful but delicate provisions of science, and we must perforce accept such roads as nature points out, and treat her indications with respect.

The Indian borderlands.

It is therefore appropriate to commence with a general description of the most marked of the physical characteristics of that region of mountains and highlands which shuts off the Peninsula from the rest of Asia, and which we call the Indian borderlands. We will start from the arid shores of Baluchistān.

Southern Baluchistān.

Southern Baluchistān (including Makrān) has been variously, and sometimes erroneously, described by many writers, from the days of Herodotus to those of the latest Census Report. A short but concise description of Makrān has been given us by one of the greatest of the mediaeval Arab travellers, Ibn Haukal, and it is at least fairly accurate, if not exhaustive. 'Makrān is a vast country, mostly desert,' says this writer. On the whole it is desert—a dried and withered country—having lost much of a former water supply which once rendered the greater part of it not only habitable but fertile. It is full of the relics of ancient irrigation works, dating back probably to the era of Himyaritic occupation. Nevertheless Makrān even now includes long but narrow valleys of very great fertility, where date palms flourish and fruit is cultivated amid fields of wheat and maize. These valleys run mostly east and west, and they are bounded by long rugged ridges of barren rock, wrinkled and folded in parallel lines, and often packed in close formation across the wide

spaces intervening between them. The drainage is often antecedent to the ridge formation, when it splits the axis of the folds, finding its way to the sea through narrow clefts and gorges. This structure is only a link in the long series of similarly elevated and folded anticlinals which distinguish the frontier formations generally. Throughout Baluchistān, from the Gomal river southwards, the frontier barrier is composed of lines of uplifted serrated strata from which the softer material has been denuded, filling up the intervening troughs, and leaving the edges of the harder rock in stiff and broken ranks, ever rising in altitude one behind the other, from the Indus valley plains to the great limestone backbone of the Sulaimān system. Then they fall away in more gentle grades to the uneven plateau of the hinterland. Sometimes the face of the rocky ridge fronting the eastern plains presents an unbroken level wall of great natural strength, such as no man can pass, for hundreds of miles. Such is the Kīrthar range, stretching northward from the Karāchi frontier to the passes of Kalāt. At other points the transverse lines of drainage open up ways more or less constricted or narrow, ramped with the detritus of ages, and leading from one sloping valley to the next, through rock-guarded gateways, ever upward from the plains to the plateau. Such are the passes of Mūla, of Mashkāt and Bolān. At one point, opposite to Jacobābād in Sind, a deep indentation, or bay, in the hills disturbs the symmetry of these parallel flexures, and drives them into curves, pushing back the line of ridges as with a wedge, piling them into huge *massifs* at the apex. This is the Gandāva basin (Kachhi Gandāva), which opens the way to Quetta. Quetta thus lies in an open plain, 5,500 feet above the sea, surrounded by gigantic peaks (Takatu, Chiltan, and Murdār), the highest that are to be found south of the Himālayas. But throughout the banded formation of hills which guard the lower Indus valley the same natural causes have produced the same shrinkage, or wrinkling, of the earth's crust; so that the same physical features are to be distinguished throughout, in spite of interruptions and breaks and the alteration of the general axis or line of strike. South of Quetta, about the latitude of Kalāt, a division occurs in this banded gridiron formation. The outside or easternmost ridges retain their original strike, and reach down southwards to the sea. The inner ridges curve gradually westward, accentuating the curve as they proceed southwards, till they are running east and west in Makrān, and so continue

in rough lines of parallelism along the border of the Arabian Sea and through Persia to the north of the Persian Gulf. The Makrān formation is but a link in the series. Between the parting of the ways, where the inner lines of ridge and furrow strike off westward from the outer, lies the little alluvial state of Las Bela. Here a comparatively small river, the Porāli (the Arabis of the ancients), drains the triangular area, and has spread abroad alluvium sufficient to ensure a fairly prosperous agricultural landscape.

It should be clear from this brief outline of the general formation of the frontier hills of Baluchistān that all the main lines of communication are shaped by the valleys, passing through the endless troughs enclosed within the lines of rocky serrated ridges; and thus it is that from the Persian frontier to Quetta routes may be found which encounter no formidable water-partings and cross no difficult passes. It follows also (although not quite so obviously) that from Kandahār in Afghānistān to the sea southwards equally easy passages are to be found, involving little or none of the constructive difficulties which have ever beset those lines of railway which take the frontier hill formation at right angles, cutting across the axis of the ridges.

Northern Baluchistān.

North of Makrān (which is but a maritime province, barely 100 miles in width), north-west of Las Bela, and west of Kalāt, is a basin of inland drainage: flat, stony, sand-wasted and bare for the most part, but cultivated in patches, gently subsiding to a level of about 2,000 feet above the sea, more or less intersected with dry stone-dusted hills, and generally presenting the aspect of broad wastes of undulating sand-dunes, or dry alluvial flats with a scanty sprinkling of low scrub. The intermittent drainage of this generally desert country passes into swamps, or lagoons, which widen their borders, or restrict them, according to the changing inflow, and are intensely saline at low ebb. The Māshkel Hāmūn (or swamp) receives the waters of the Rakhshān, which rises near Kalāt to the north-east, as well as those of the Dizak, which drains the volcanic regions to the north-west, east of the great Kirman desert. Into the Māshkel also drain the scanty waters of Khārān, the home of the desert-bred Nausherwāni tribes. The Lora Hāmūn (not 100 miles removed from the Māshkel) receives the river of Pishīn. The wide outspread of the Seistān Hāmūns (on the Perso-Afghān border, north of Baluchistān) receives the full tide of the Helmand river (rising near Kābul), as well as the waters of

many streams from the north-east intersecting the highlands of Central Afghānistān. These Seistān Hāmūns are provided with an overflow outlet in the Gaod-i-Zirreh, an extensive salt swamp the north-eastern edge of which is only a few miles from the Helmand at the point where it bends northward. Thus the Helmand pours its flood-waters first towards the south-west from Kābul, passing to the north of Kandahār; then due north to the Seistān lagoons; and finally, reversing direction in its overflow, turns them back from these lagoons in a counter-march on their northerly course to find final refuge in the Gaod-i-Zirreh. The greater part of this great inland basin with no sea outlet (which is only one instance of a common feature in Asiatic physiography) is desert or waste land, spreading itself on either side the Helmand into Southern Baluchistān and the Kandahār province of Afghānistān. The green valley of the Helmand, which intersects it, receives no tributary stream from north or south for the last 200 miles of its course. It is only a narrow ribbon of fertility, dividing the flat barrenness of Chakansur from the waterless tracts north of the Koh-i-Amīr and the Lora river. But the latter river now feeds the lately developed luxuriance of Pishīn; and many of the upper affluents of the Helmand within the borders of Afghānistān, as well as the streams which run southwards from Herāt in their course from their highland sources to the Seistān swamp, pass through regions of fair abundance, where the wheat-fields are intersected with poplar-shaded canals, and orchards cluster in thick growth around the villages.

Southern Baluchistān is the home of the true Baloch, descended from an Arab ancestry, still largely nomadic in his proclivities, proud of his race and lineage, and redeemed from barbarism by chivalrous instincts derived from his forefathers. Together with the Arab, there are Kurdish peoples, with later Persian and Dravidian races, intermixed with an original Tājik (or ancient Persian) stock. But there are no Pathāns, or Pashtū-speaking peoples, in Southern Baluchistān. Northern Baluchistān (say from Quetta northwards) is Pathān, and it differs from the southern districts in that it is more mountainous (for it is more restricted to the Indus border country) and less desert in its character. The Sulaimān ranges, which traverse this northern section, culminate in magnificent peaks beset with stupendous limestone crags. The valleys are more cultivated, the wild olive abounds, and the slopes of the hills are often forest-covered.

The Pathān frontier.

From Baluchistān northward (the political boundary is the Gomal river) there stretch the narrow irregular border districts of Pathān highlands (now brought under the political control of the chief of the lately-formed North-West Frontier Province), full of uncivilized tribes, who interpose an independent buffer-land between Afghānistān proper and the red line of British India. This country is all mountainous, and through it there run the chief passes to Afghānistān: namely, the Gomal, the Tochi, the Kurram, and the Khyber, in succession from the south. Certain physical characteristics are the common property of all these passes. There is little of the ordered tectonic regularity of the Baluchistān border mountain system in the Pathān hills of the north-west. Wazīristān, immediately north of the Gomal, forms a more or less distinct orographical feature, geographically unconnected with the outlying spurs of the Safed Koh on the north, or the Sulaimān ridges on the south. Its rugged ilex-covered spurs centre on the giant peaks of Pīrghal and Shuidar, overlooking the plains of Afghānistān towards Ghazni. To the north of the Wazīristān mountain group lie the long-extended foothills of the great transverse Safed Koh range, which stretches its length almost due east and west, parting the valleys of the Kurram and the Kābul almost at right angles to our frontier. Its southern offshoots enclose the head of the Kurram, and form the dividing ridges between the Kurram and the Tochi. The magnificent proportions of the Safed Koh, its altitude, its severely straight yet rugged outlines, distinguish it among the minor ranges of Northern India. It rivals the Sulaimān range, crowned with the historical Takht-i-Sulaimān, in the grandeur of its array of lofty peaks. The Kābul river, at the northern foot of the Safed Koh, absorbs the drainage of the southern slopes of the Hindu Kush, which, from the far north, extends its long level spurs parting the waters of many historic rivers, among which are the Kunar (or the river of Chitrāl), the Panjkora, and the Swāt. All the mountains to the north of Kābul are but outliers and spurs of the Hindu Kush, which circles round, enclosing Kābul itself and all the arteries of the Kābul river-basin in its embrace, ere it strikes away to the west, and merges into another great mountain system, which parts Southern Afghānistān from Afghān-Turkistān. It would perhaps be geographically correct to include the Safed Koh as an extension of an arm of the Hindu Kush; and to note that the Kābul river breaks across the chain, splitting it apart in its course between

Dakka and the plains. But there is none of the weakness of a long-extended offshoot about the Safed Koh. It maintains all the magnificent proportions of an independent range, and it is thus that it is generally recognized. One result of this distribution and structure of the Pathān mountain borderland is that the drainage lines supporting the routes which traverse it (and which represent the extent of British occupation) are not structurally similar to the passes of the south. It is true that they traverse narrow mountain gateways as they approach the plains of India, and that they are usually enclosed by steep-sided hills; but they frequently expand into comparatively wide alluvial plains, with a gentle slope through which the rivers wind and twist in many channels, and seldom (until they reach the ridges which bound the plains of the Indus) split a waterway for themselves across the axis of the hills. There is more lateral expansion (especially in the valleys of the Tochi and the Kurram) and less of defile, or gorge-gripped formation, in the course of these rivers from the plateau to the Indus.

Behind and beyond the band of border mountains lies Afghānistān, less approachable now than it was fifty years ago, and still the greatest Muhammadan kingdom of the world after Turkey. Afghānistān slopes gently downwards from north-east to south-west, but never falls below the 1,500 feet line of altitude above sea-level, which is about the elevation of the ultimate bourne of the Helmand in the Gaod-i-Zirreh swamp. In the north-east the level of the valleys is about 4,000 or 5,000 feet, and the crests of the Hindu Kush mountains tower above them to 20,000 feet; but there are no great altitudes in the south-west, and the western borders of the country maintain a general average of about 3,000 feet from Herāt to Kandahār. Four great river-basins absorb nearly the whole drainage of Afghānistān: namely, the Kābul in the north-east; the Oxus (including the Oxus desert) on the north; the Helmand in the centre or south-west; and the Indus, which takes that border fringe of river affluents rising to the west of the independent borderland. To this must be added the minor basin of the Hari Rūd, the river of Herāt. Afghānistān.

A remarkable feature about Afghān hydrography is the comparatively small amount of it which has connexion with the sea, or even with the Oxus or the Indus rivers. The desert tracts south of the Oxus, and those about Merv, absorb nearly all that waters Afghān-Turkistān. The desert of the Helmand takes

the inflow of the many streams which traverse the central highlands; and but few of those which wind through the gorges and gullies of the Sulaimān hills ever actually join the Indus, being absorbed before they reach that river. The Kābul river alone, with its great northern influx from the glacier-bound ridges and rifts of the Hindu Kush, carries a full tide to the Indus; and even the Kābul river and the river of Herāt (the Hari Rūd), and many another promising source of fertility and strength to the land, often run dry in their upper courses at seasons when their waters are carried by a thousand minor channels into an artificial system of irrigation. There are no more expert irrigation engineers in the world than the Afghāns. They utilize every drop of water when water is scarce. They outwit the Persians, and rival the Chinese, in their practical knowledge of the art of making green things grow in dry places.

The northern province of Afghānistān, the province of Kābul, pushes itself into the very heart of the mountain masses which buttress the Pāmirs and hide the wild valleys of Kāfiristān. The Hindu Kush is the range *par excellence* of Northern Afghānistān, from the point of its parting with the ice-bound Muztāgh to its junction with the dividing ridges of the Band-i-Turkistān and Koh-i-Bāba, where it overlooks the plateau beyond which lie the deserts and oases of the Oxus basin. Rugged and elevated as the Hindu Kush may be, it is not Himālayan in its mountain characteristics. There are few peaks of quite first-class significance (the most majestic and the most prominent of them are to be found based on its flanking spurs), and there are several depressions across which comparatively easy by-ways connect the north and south. It is not the Hindu Kush watershed itself which forms the northern barrier to India, but the inconceivably difficult approaches to which its passes lead. The most famous of all the Hindu Kush passes (historically) is that which is said to derive its name (Hindu Kusht, or 'dead Hindu') from the fate which once befell a Hindu force on its summit, and which is but one of a group leading from the Oxus basin to Kābul. This has indeed been a veritable highway of the nations. This way came Alexander with his Greek following, and it would take a chapter to record the successive tides of human migration (Scyth and Mongol) which have swept through those frozen gateways to the north of Kābul. We can only note *en passant* that such history is very unlikely to repeat itself. From the point which is geographically the western termination of the Hindu Kush system (a little

to the south-west of Kābul) long spurs and offshoots descend, radiating slightly west and south-west from their base through Central Afghānistān, and forming that series of inconceivably wild and inhospitable uplands which are the home of the Hazāra and kindred tribes of the Chahār Aimāk. It was within these hills that the ancient capital of Ghor once stood, and it is at the base of these long-extended offshoots that some of the richest land in Afghānistān now exists. The physical characteristics of Baluchistān—the dreary monotony of stone-covered waste, with scanty scrub and struggling vegetation clothing the hills with green patchwork—are not to be found north of its south-western deserts, nor in Afghānistān, where the northern hills are rich with verdure, and their pine-clad summits are but the prelude to the yet richer mountain landscape of Kashmīr.

Of the 246,000 square miles which are included in the kingdom of Afghānistān probably three-fourths are mountainous. Kābul, at a height of 5,780 feet above sea-level, is enclosed among the spurs and foothills of that part of the Hindu Kush which was once known to the Greeks as Paropamisus. Herāt, at the lower altitude of 3,026 feet, is still overshadowed by mountains, which close in the long narrow valley of the Hari Rūd like the sides of a trough. Kandahār (3,462 feet above the sea) is less dominated by mountain formation. The hills about Kandahār partake of the characteristics of the Baluch mountains, breaking into scattered straight ridges with scarped flanks and serrated crests. The valleys of the Kābul basin are usually narrow, winding between the mountain folds or shadowed deep in cliff-bound gorges; but where these gorges occur at the outlet of the valley, they not infrequently cause an accumulation of alluvium and a widening of the open plain above them, which affords opportunity for the existence of clusters of villages and a fair spread of cultivation. The Kohdamān valley, north of the city of Kābul; the valley of Laghmān, from which the Kābul river emerges by the narrows of Domandi; and the valley of the same river near Dakka, above the narrow outlet of its passage through the Mohmand hills, are instances of this formation. South of Kābul, beyond the basin of the Kābul river, there are many extensive valleys, teeming with villages and highly cultivated. The great (and almost level) high road from Kābul to Kandahār passes through a fairly rich country, a land of irrigated fields and green pastures. The valleys of Chardeh, Maidān, Wardak, and Kohistān are

visions of luxuriant beauty in the fruit-ripening months of Northern Afghānistān. The most productive areas, however, are undoubtedly those of the west and south. Herāt is the centre of a comparatively restricted valley, which is of exceptional fertility; but the area which can be brought under crops by the blue-coated Tājik husbandman with his triangular spade is limited by the water supply of the Hari Rūd and the steep slopes of the enclosing mountain wall. It is probable that the richest districts of Afghānistān are those north of Kandahār, which are watered by the Arghandāb and the lower Helmand; but they are also the least known.

The geographical position of Herāt with reference to Central Asia and India is of peculiar interest. Near Herāt there exists the only break in the otherwise continuous and formidable wall of mountains which traverses Asia from the Bering Strait to the Caspian Sea. Near Herāt it is possible to pass from the Russian outposts and the Russian railway system to India without encountering any formidable altitude—and this is possible nowhere else.

The hinterland of Kashmīr.

Turning again to the north of Afghānistān and the borders of Kashmīr, we find a thin arm of territory reaching outwards on the extreme north-east. This arm includes the Little Pāmir, which here interposes as an Afghān buffer between Russia and the hinterland of Kashmīr. The southern boundary of the Little Pāmir is formed by the crest of the Hindu Kush, which unites at the extreme eastern limits of the Pāmir with two other gigantic mountain ranges: one, running northward, separates Russia from China; the other, running south-east (under the name of Muztāgh), divides again into two mighty arms eastward and south-eastward, and encloses between them the rugged and elevated horn of North-western Tibet, parting those desolate uplands from Chinese-Turkistān on the north, and from the trans-Indus borderlands of Kashmīr on the south-west.

The square block of Kashmīr territory (excluding the Chitrāl hinterland, which is not politically an integral part of the State) is traversed across its width by the deep trough of the Indus river, which here runs from south-east to north-west, sometimes sliding over broad shingly beds, sometimes breaking into cataracts amid vast mountain solitudes. Changing suddenly to a south-westerly course, in about 75° E. long. (a little to the east of Gilgit), it makes its way to the plains of Peshāwar through mountain districts so wild and unapproachable as to

be even yet only partially explored. To the west of this part of its course lies the Gilgit extension of Kashmīr territory, and the passes therefrom to the Pāmirs and to Chitrāl. Farther south are the upper valleys of Buner, Swāt, Bājaur, and all the wild borderland of hills which lies north of Peshāwar and east of Kāfiristān. No part of the Himālayas lies beyond the Indus, either west or north. To the west we are immediately confronted with the long offshoots of the Hindu Kush. To the north we meet another system, the Muztāgh and its Karakoram extension. The great bend of the Indus encloses the Himālayas on the north-west, as the bend of the Brahmaputra enfolds them on the south-east; the two rivers starting from nearly the same central point, and forming deep troughs at the back of the Himālayan system during their earlier and glacier-fed stages of existence. They may be considered as the natural drains of a gigantic ice-bound wall, pouring their glacial floods in opposite directions to either side of India. Their deeply eroded valleys are, however, but scratches on the vast surface of the elevated region of which the Himālayas with their multiplied bands of ridge and range form the abutment. The Himālayas are the wrinkled and corrugated southern edge of the great Tibetan plateau, corresponding in many of their most important geographical features with the Kuen-lun abutment on its northern edge, and not separated from the plateau by the accident of the Indus and Brahmaputra drains.

The Native State of Kashmīr includes about 200 miles of the most elevated crests of that magnificent mountain system, the Muztāgh. Dominating these crests are such gigantic peaks as Godwin Austen (28,300 feet), Gasherbrum (28,100), and the wonderful white pinnacle of Rakaposhi, north of Gilgit, which with the comparatively modest altitude of 25,561 feet combines the grace of the Matterhorn with the majesty of Mont Blanc. To the south of the Indus we have the initial peaks of the great Himālayan ranges (notably of the Zāskār), which stretch their length through nearly 1,000 miles from the *massif* of Nanga Parbat (26,182 feet) to Kinchinjunga (28,000) and Everest (29,000), crowned with a glittering array of magnificent snowy peaks, and unbroken save by the deep-cleft passages of the upper courses of the Sutlej and Gogra, which form the mighty northern barrier between India and Tibet.

The Vale of Kashmīr.

The Kashmīr of the British holiday-maker is, however, not the Kashmīr of the Indus basin, but of the basin of the

Jhelum, centring on the capital, Srīnagar, and lying spread between the Zāskār range on the north and the Pīr Panjāl offshoot on the south. This is but a comparatively small section of Kashmīr territory, and it owes its marvellous fertility and its unapproachable beauty to the geographical distribution of the surrounding hills. These close in the passage of the Jhelum at Bāramūla, where it bends southwards when making for the Rāwalpindi plains, and thus vast stores of alluvial wealth have been snatched from the river to spread on either side in gentle grades and sweet smooth slopes. The cold bleak highlands of Deosai and Ladākh, beyond the Zāskār, and the open, wind-swept, dry-salted solitudes of the north-eastern plains adjoining the Tibetan border, are not much traversed by Europeans, although the passes leading to Gilgit—i. e. the Tragbal and the Burzil, the Astor valley and Bunji—are now tolerably familiar. The beauty of Kashmīr is the beauty of its western and southern districts, where Nanga Parbat looks across the deep-shadowed valley of the Indus to Rakaposhi, or where Harāmukh is reflected in the purple waters of the Wular Lake. The physiography of Kashmīr in relation to the Peninsula of India is economically most important, inasmuch as the great reservoirs from which is drawn the water supply that fertilizes the vast flat plains of the land of the five rivers are contained therein. Here are born the infant streams which feed the Indus, the Jhelum, the Chenāb, the Rāvi, and, to a great extent, the Sutlej also. Kashmīr is the great natural storehouse on which the wealth of a third of India depends. Economically, again, the climatic conditions of the country are important; for it is here that European colonization is to succeed, if it succeeds anywhere in India. The English race has never yet taken root in India, but it seems possible that with more facilities for occupation Kashmīr might become a white man's country.

The Himālayas. Eastward of Kashmīr, across the wide frontier of Northern India, the Himālayas continue to part India from Tibet. From the great central range of snowy peaks to the Indo-Gangetic plain there exists a width of about 100 miles of mountains, comprising many minor ranges, steep-sided and deeply eroded by river action, distributed with a general approximation to parallelism with the strike of the great central range, but often highly irregular in conformation. Where these ranges have a northern aspect, they are usually forest-covered to their summits. On the southern slopes,

the folds of the hills are often bare and dry, subject to forest fires and the depredations of flocks and herds. Wherever the winter sun touches these outer hills, there, if the slopes be not prohibitive, is the commencement of terraced cultivation, which is often carried up through thousands of feet until the whole mountain-side appears to be but a succession of staircases with green-carpeted steps. Under British protection the cultivation of the Himālayan valleys, around such centres as the hill stations, is increasing rapidly. The magnificence of the forest scenery of the Himālayas, crowned by the everlasting snows, is indescribable. The scarlet masses of the rhododendron woods in May are the glory of the hills about Simla; the sub-tropical forest growth of tree-ferns and bamboos which clothes the feet of Kinchinjunga strikes the key-note of landscape beauty in the valleys beyond Darjeeling.

From the southern foothills of the sub-Himālayas there extends a width of high-level territory, flanked by an outer ridge of recent formation known as the Siwāliks—a feature which is common to Himālayan structure throughout most of the north-western extension of the system. The Siwāliks are famous in geological annals for the wealth of palaeontological evidence which they have given to the world. Physically they are but a line of broken and disintegrating hills which mark the first step upward from the plains, enclosing an area of great richness lying between them and the Himālayan foothills. These upland valleys skirting the mountains are usually called Dūn, and they include some of the most fertile and most beautiful of Indian lowland formation in the north-west. The Siwāliks.

The Central Himālayas are bordered by densely forest-covered tracts called Tarai, or (on the extreme east) Duārs. The Tarai or Duār forests are generally reckoned to be the most deadly of all the fever-haunted jungles of Northern India, and yet they cover many strange relics of ancient civilized development. Within their embrace, immediately south of Nepāl, are hidden the buried remains of some of the most famous among mediaeval Buddhist cities. The Tarai.

The physical aspects of the Himālayas are only partially known to us. The Districts of Kumaun and Garhwāl, adjoining Kashmīr in the North-western Himālayas, and the State of Sikkim in the south-east, are the best-known regions of this stupendous mountain system. It cannot be said that we Physical aspects of the Himālayas.

are acquainted with more than the main features of Nepāl, or that we know much of the physiography of the eastern hills which cradle the affluents of the Brahmaputra. With a climate and vegetation ranging between arctic and tropical, the conditions of life within the valleys overshadowed by the gigantic peaks of the Himālayas are infinitely varied. Even the accidents of position in relation to the sun's rays are recognized by the natives of the hills as requiring special terms to denote them, so obvious is their influence in moulding human form and character. Within the limits of a single valley (where there may, however, be space enough to accommodate the whole European Alpine system) there will often be found varieties of human type which might almost indicate divergency of origin.

Himālayan passes.

The main passes across the Himālayas may be divided into three groups. Firstly, the Shipki group, which marks the line of connexion with Tibet afforded by the passage of the Sutlej river from the highlands beyond the northern flank of the Himālayas to the plains of India. This group includes a route which has for many years been regarded as the commercial high road between India and Tibet. Probably it originally determined the position of Simla, and with the expansion of Simla developed into more than a mere mountain track. It is for a considerable part of its length a well-engineered road, but as a trade route it has never proved a success. Secondly, there is the Almorā group, which determined the position of Nainī Tāl and Almorā, and lies to the north of them. Across these tracks a certain amount of traffic is always maintained, chiefly by the agency of sheep as transport animals. A little to the east of the Almorā group is the opening through the hills effected by the chief affluent of the Gogra river, which rises not far from the birthplace of the Indus, the Brahmaputra, and the Sutlej—that remarkable hydrographical focus contiguous to the Mānasarowar Lakes. The third group crosses the northern barriers of the State of Sikkim from Darjeeling to Southern Tibet and Lhāsa. Thus all the main passes of the Himālayas strike into the elevated table-lands of Tibet, even including those which belong more correctly to the trans-Himālayan area centring on Leh, the Ladākh capital in the far north-west, as well as the Bhutān passes of the far east. None of them is passable except for trade purposes; none of them at present contributes anything material to the commercial prosperity of India.

Hill stations.

The chief hill stations of the Himālayas are naturally connected with the chief roads intersecting the mountains. Murree is the post-town for Kashmīr. Simla points the way to the Shipki group of passes, Nainī Tāl and Darjeeling to other groups. Mussoorie and other minor sanitaria depend largely on their accessibility from the plains, or on the exigencies of military administration, for their existence. The geographical position of Simla is interesting. The town (or rather the church around which the town gathers) is on the parting of the waters between the Sutlej and the Jumna. It thus marks the great divide of the Indo-Gangetic plain, dominating one of the most remarkable features of Indian physiography.

The north-eastern borderland.

The borderland of India is rounded off on the east by Burma. The Himālayas may be said geographically to terminate in the north-west at the great bend of the Indus. Similarly they are enclosed on the south-east by the great bend of the Brahmaputra. Between the sinuous curves of these two mighty rivers the mountains are enfolded; beyond them are mountains again, but of different physical conformation, if not altogether of different physical aspect.

Among the many physical features of the Indian frontier that may be destined to play an important part in Indian history, is the great highway of the Brahmaputra valley from the plateau of Tibet to the plains of Assam. This magnificent natural outlet of the glacier and snow-fed drainage of the north is still a matter of speculative interest to geographers, although enough of it is known to justify the expectation that it may yet be recognized as one of the world's highways. Near the frontier station of Sadiyā in Upper Assam three important streams unite to form the Brahmaputra of the plains. From the north flows the Dihāng, now known to be the continuation of the Tsan-po of Tibet. From the north-east the Dibāng makes its placid way, and from the east the Luhit. The two latter are of more than local significance; for the valley of the Dibāng points the way to the richest of Tibetan provinces, and the Luhit leads by a comparatively short, but most difficult, route directly to the borderland of China. But it is the Dihāng or Brahmaputra valley, with its possibilities for agricultural development in the cultivation of tea, coffee, and fruit, its gradually ascending grades to the great uplands, its wealth of villages about the lower reaches, and the magnificent series of falls which form an abrupt step to its upper levels, that calls chiefly for the practical interest of the explorer and the

engineer. It is here, however, that we encounter the most determined opposition from a small group of utterly barbarous sub-Himālayan tribes (the Abors, Mishmis, &c.), who block the way between India and Tibet, and with whom political relations have hitherto been found impossible unless supported by armed force.

Burma.

Northern Burma is a comparatively new creation, belonging to recent geological periods, but parted from the recent upheavals of the north-west and of Tibet by the great mass of the South-eastern Himālayas, and from the Gangetic plain by the hills of Assam. The Assamese hills and plateaux (peopled by Gāros, Khāsis, Nāgās, and other Indo-Chinese tribes) are probably a part of the ancient mainland of Jurassic times, which extended from the Eastern Himālayas to Africa. The Gangetic depression is of later date, but palaeontological evidence does not indicate that any wide strait ever existed between the Peninsula and the Himālayas in the ancient distribution of land and sea. The character of the Assam hills denotes a result of tectonic force different from that which has folded the hills of Northern Burma in parallel and narrow flexures. There are comparatively wide undulating uplands with cliff-bound edges and spurs radiating therefrom in irregular formation, and exhibiting an absence of that meridional strike in the axis of main ridges which is the distinguishing feature of the Burmese hills flanking the Chindwin affluent of the Irrawaddy, or rounding the bend of the Brahmaputra. These newer mountain formations, springing from the eastern extension of the great Tibetan plateau, almost appear to have been constrained to adjust themselves to a pre-existing mass of the Eastern Himālayas, folding and curving like the waves of an approaching sea, wave after wave in long sinuous lines breaking against the containing wall of the Brahmaputra and reaching down the western coast of Burma, till they terminate southwards in the Arakan Yoma, which parts the basin of the Irrawaddy from the narrow littoral regions east of the Bay of Bengal. So stiff, so steep, and so densely forest-covered are these solid waves, that the path across them connecting Upper Assam with Burma is one of abnormal difficulty, and so far has proved an insurmountable stumbling-block to railway engineering. But beyond them, to the east, the Chindwin and the Upper Irrawaddy form delightful valleys, full of cultivation and the gladness of life, possessing a good climate and much landscape beauty; ever presenting new openings and fresh inducements for economic enterprise. All Northern Burma is mountainous, and

the Irrawaddy occasionally narrows to a much-restricted channel between the hills. It is, however, usually a broad and noble stream, island-studded and placid, reflecting the deep masses of broad-leafed vegetation, and the gracious spires and towers of Burmese pagodas. An interesting feature of the geography of Upper Burma is the source of the Irrawaddy. In Eastern Tibet there occurs one of those hydrographic origins or centres, from which the infant affluents of great rivers take their parting ways, such as we have referred to in Western Tibet near the Mānasarowar Lakes. Here the Hoang Ho (the Yellow river) and the Di Chu, or Yangtsi Kiang of China, start on their eastward courses. Here (or near here) also the Nām Chu, or Mekong (the river of Siam), takes its rise. Here, too, is the source of the Giama Nu Chu, which is undoubtedly one of the main rivers which traverse Burma from north to south. Is this the same as the Salween? or is it but the commencement of the Nmai Kha, the eastern affluent of the Irrawaddy, joining it above the railway terminus at Myitkyinā, 150 miles north of Bhamo? Indian surveyors now connect it with the Salween, but its course cannot be said to be absolutely determined. The province of Upper Burma includes six administrative divisions, two of which are the Northern and Southern Shan States. The Shan country rises to the east of the Irrawaddy valley, and is described by every traveller who has visited it as a land of great promise. Orchid-bedecked forests and undulating wheat-covered plateaux, possessing a varied and productive soil, are its chief characteristics; but the intersecting drainage lines are deep and steeply enclosed, making it a difficult country to traverse, and rendering the cost of railway construction almost prohibitive. Lower Burma, with a more humid atmosphere and lower levels, does not enjoy the climatic advantages of the northern province. The teeming soil of the great deltas of the Irrawaddy and the Salween, with a vast commercial network centring on Rangoon and Moulmein, ensure its wealth on easy terms of agricultural labour; but the broad flat lowlands and the steamy enervating atmosphere will ever render it inimical to European existence.

Such then, in very brief review, are the general physical characteristics of the borderlands of India—borderlands which can never again be left out of account in dealing with Indian physiography. The material wealth of India largely depends on their capacity for the storage of that water supply which carries fertility to its broad plains; the strength of India depends on the nature of the bul-

warks which they afford for frontier defence; the future of India depends on the manner in which we maintain those defences, guarding the gateways and portals of the hills, and preventing those landward irruptions which have so often changed her dynasties and given a new ethnographic strain to her people.

The Indo-Gangetic depression.

The Peninsula of India is parted from the northern area of upheaval, of which the Himālayas are the southern revetment, by a broad interval of low flat country known as the Indo-Gangetic depression. In some respects this is the most important physical feature of India. Within the basin of the Ganges have ever been founded the chief kingdoms of the plains; the most ancient cities; the earliest centres of civilization, of industry, and of wealth. The mighty river has silently worked through the ages in an unceasing process of regeneration of the soil, spreading life and strength abroad among the millions who venerate its sanctifying agency and purify themselves from sin in the turbid flood which laps the temple steps of Hardwār and Benares. From the delta of the Ganges to the delta of the Indus this strange wide region of depression extends. Within it is not to be found a boulder (not even a pebble) to break the uniform regularity of its alluvial surface. It is these heat-stricken plains, rather than the mountains of the north or the plateaux of the south, which have given India its colouring in history, and from which was derived the popular conception of the India of last century. Since the geological era in which occurred the parting of the waters, when the Indus affluents first started westwards and those of the Ganges turned their currents to the east, the physical character of the two basins has rapidly diverged.

All of the Gangetic basin is within the influence of the south-west monsoon rains; and the thick humid atmosphere of steamy effervescence, which is the characteristic of Lower Bengal and of those provinces to the south which are watered by the Mahānadī, makes all the land green with the luxuriance of vegetation. From the extreme north-western extension of the East Indian railway system to the delta of the Ganges and Calcutta, the traveller passes through nothing but a wide area of crop-producing land, broken by clustering groves of mango, tamarind, and other trees, giving place gradually to long lines and avenues of palms bordering the fresher verdure of irrigated rice-fields in the lower reaches of the valley.

The prevailing evidence of agricultural wealth becomes almost oppressive in its monotony. Where the majestic flood of the Brahmaputra leaves the mountain-bordered valley of Assam, losing sight of the forest-clad slopes of the Himālayas and the far-off snows amid which it had its cradle, to pour its mighty volume of silt-bearing waters into confluence with the Ganges, there India widens out into an endless panorama of irrigated fertility: a wide network of canals; an endless procession of picturesque villages containing a swarming population. Very gradually this merges southwards into the deadly swamps and flats of the Sundarbans. The rainfall is certain, and it is abundant. It is at the head of the Bay of Bengal, where the vapour-bearing currents of the monsoon first strike the edge of the Assam hills south of the Brahmaputra, that the greatest rainfall in the world is recorded. It occasionally amounts to over sixty feet in the year.

The Ganges and the Jumna.

The Ganges, assisted by its great tributaries—the Jumna, the Gogra, and the Gandak—drains the southern slopes of the Himālayas from Simla eastward, carrying fertility and wealth to the plains of Bengal. Tracing magnificent curves through the flat lowlands, the four rivers have for centuries combined to form an overruling factor in the development of the Indian races. No river on the surface of the globe can compare with the Ganges in sanctity. From her source to her outflow in the Bay of Bengal every yard of the river is sacred. To bathe in the Ganges at stated festivals is to wash away sin; to die and be cremated on the river bank is to attain eternal peace; even to ejaculate the name 'Gangā' when afar from her banks is sufficient to atone for the misdeeds of several previous stages of human existence.

The total length of the Ganges is about 1,550 miles. Rising in the Central Himālayas, the glacial ice-cave of its birth is known as the Gaimukh or Cow's Mouth. Here the Ganges is but an infant stream (locally known as the Bhāgīrathi), 27 feet broad and 15 inches deep, at an elevation of 13,800 feet above sea-level. For the first 180 miles of its course above Hardwār the Bhāgīrathi is a snow-fed mountain torrent, rapidly developing into a river of broad shoals, long deep pools, and occasional rapids. The great system of irrigation which commences at Hardwār occasionally carries away the whole of this volume of mountain waters. At the end of the next thousand miles of its course the Ganges is a broad shining river, flowing in easy channels through a flat landscape, broken

only once by the isolated crests and slopes of the Rājmahāl hills. At this point its flood discharge amounts to a million and a half of cubic feet per second. After passing Allahābād (at its confluence with the Jumna) the fall of the Ganges drops to six inches per mile, and through the last 200 miles of its divided course—through the plains and swamps of the delta—it is even less. Jamnotrī, the source of the Jumna, is not far removed from the peaks which give birth to the Bhāgīrathi. The Jumna issues from the foot of the most notable of all the array of magnificent snow-clad peaks which group themselves at this point of the snowy range, at an elevation of 10,850 feet above sea-level. The river runs an independent course through mountains and plains of 860 miles ere joining the Ganges at Allahābād, where, on a narrow tongue of land parting the two rivers immediately above their confluence, is the true Prayāg, the most sacred bourne of Hindu pilgrimage. The clear blue waters of the Jumna can be distinguished from the yellow silt-charged Gangetic stream far below their confluence. The Jumna, like the Ganges, spreads fertility abroad through the agency of her canals both eastward and westward, reducing her own volume to comparative insignificance during the hot weather. A useful contribution to the Jumna is derived from the south, by the channels of the river Chambal, which drains the gradually rising slopes of the Central Indian plains. The Nepāl affluents of the Ganges—the Gogra and the Gandak—also form most important additions to the Gangetic system. The Gogra, like the Sutlej, breaks through the rampart wall of the Himālayas.

The plains of the United Provinces and of Bihār rise in gentle undulations away from the river banks, dotted with mud villages and adorned with noble trees. The villages cluster thickly, and the brown masses of mud buildings, flat-roofed, cool, and scrupulously clean, are chequered by the purple shadows of the trees under which the village folk gather in the cool of the evening to gossip and discuss the food prices of the nearest bazar. Their talk, as they sit on the *chabutra* round the vermilion-daubed figure of the benevolent god Ganesha, is ever of 'pice'; and their prayer is ever for rain. Stretching from village to village, and linking together the country communities, runs the great white *kankar*-made road of the Sarkār, with long avenues of trees giving welcome shade to the creaking bullock-carts and to the white dust-powdered figures of the passing wayfarers. Beyond the road and the villages, reaching to the level horizon, are the fields of

the peasants, ripe with harvests of millet, sugar, wheat, or Indian corn in the autumn, or stretching away empty in brown folds under the yellow heat haze of early summer. This is what may be seen over thousands upon thousands of square miles through a great space of Northern India.

When the Ganges reaches its delta in Lower Bengal (330 miles from its journey's end) the fall of the river is so slight that the current, seldom sufficient to enable it to carry its burden, deposits its silt. Checked by the rising level of the silt-formed plains the river splits into many channels, which again throw out their own distributions right and left. The country so traversed and intersected with waterways is the true delta, which commences where the head-waters of the Hooghly break off from the main stream. Between the Hooghly and the main river these inosculating streams struggle slowly seawards to end in a wilderness of forest and swamp, throwing up new levels, pushing out fresh headlands, and constantly changing the topography of the land surface, even as the lower Ganges itself changes its channel and adopts new water-ways within the limits of its own riverain. The deltas of three great river systems unite in Lower Bengal: those of the Brahmaputra, the Meghnā, and the Ganges. Where the Brahmaputra rounds the Gāro hills, there commences the delta of that river; where the Meghnā combines the southern rainfall of the Khāsi hills with the western drainage of the watershed between Bengal and Burma, there commences (in Sylhet) a third delta. The delta of the combined rivers, covering 50,000 square miles, appears to have experienced successive eras of vegetation and then of submergence. Four hundred feet of delta deposit now cover this island built up by the three rivers of Bengal, and yet its surface is often but a few inches above the sea. Here the ordinary landscape is a flat stretch of rice-fields, fringed around with an evergreen border of bamboo, coco-nut, areca, and other coroneted palms. This densely peopled tract seems at first sight bare of villages, for each hamlet is hidden amid its own grove of plantains and wealth-giving trees. The bamboo and the coco-nut play a conspicuous part in the industrial life of the people. Rice is the staple crop and the universal diet. Nearly 300 separate kinds of rice are said to be distinguished within the single District of Rangpur. The vegetable products of Lower Bengal, including drugs, resins, gums, fibres, tobacco, sugar, &c., would require a separate and a lengthy catalogue. Even the jungle is full of vegetable

wealth. 'Flowering creepers of gigantic size and gorgeous colours festoon the trees, while each tank bears its own beautiful crop of lotus and water-lily. Nearly every vegetable product which feeds and clothes a people, or enables it to trade with foreign countries, abounds.'

Great changes have taken place throughout the valley of the Ganges, even within the historic period. The river has pursued its uninterrupted course of land-building, shifting its channels from time to time; withdrawing its waters from the walls of great cities which once adorned its banks, to give life and energy in new directions. Upon its banks in the present day are such centres of wealth and commerce as Calcutta, Patna, Benares, Allahābād, and Cawnpore, with Agra and Delhi on its affluent the Jumna. There is not a river in the world which has influenced humanity or contributed to the growth of material civilization, or of social ethics, to such an extent as the Ganges. The wealth of India has been concentrated on its valley, and beneath the shade of trees whose roots have been nourished by its waters the profoundest doctrines of moral philosophy have been conceived, to be promulgated afar for the guidance of the world.

Separated though it is from the plains of Lower Bengal by a broad band of hill country, the basin of the Mahānadī (which includes the eastern half of the Central Provinces and a part of Madras) differs from them very little in most of its essential physical characteristics. A warm steamy atmosphere favours the same palm and rice cultivation, and all the conditions of a productive but enervated human existence are present. The Mahānadī delta forms the chief feature of the fertile flats of Orissa; and the widespread stretches of rice-fields, patiently parcelled into irrigated plots, and parted by narrow lines of earth divisions along which are set the stately rows of palmyra palms, are but a repetition of the features which combine to render monotonous so much of the scenery of Lower Bengal. Not far from the mouth of the Mahānadī, on the shores of the Bay of Bengal, is one of the most sacred shrines of Hindu India. Here is erected the temple of Jagannāth, that unconscious representative of a coalition of Brāhman and Buddhist doctrine who is to the devout Hindu the very type of the Vaishnav faith. On the yellow shores, where beats the eternal unresting surf, millions of pilgrims collect once a year to render homage to the god whom they ignorantly worship with a ritual that once was purely Buddhist.

The valley of Assam—extending north-eastwards from Lower Bengal, parting the Himālayas of Bhutān from a mass of comparatively low formation which now forms the outliers of the Upper Burma mountain system, under the names of the Gāro, Khāsi, Jaintiā, and Nāgā hills, after the aborigines who inhabit them—is in point of physical resemblance closely connected with Bengal. But the unending vista of flat cultivation is here narrowed to the width that exists between the broad channel of the river and the foothills on either side. River and mountain are never parted; they combine to produce an unending panorama of scenic beauty which is far more akin to Burma on the east than it is to Bengal on the west. Terraced gardens for the growth of tea climb the hill-sides or fill in the undulations of the river banks; and the atmosphere is drier, clearer, less enervating and more wholesome, by reason of the extensive clearings which agriculture develops. Nevertheless, there are enormous wastes, especially to the north of the Brahmaputra underlying the Himālayas, where forest alternates with stretches of grass or reeds, thick and dense, the home of the rhinoceros, buffalo, and tiger. Here and there roads run northward from the river-side stations, where the steamers call, to the hill country beyond, such as that which passes through the State of Cooch Behār to Buxa, or from the river to Dewāngiri; but for the most part the Duārs, or plains at the foot of the Bhutān Himālayas, are vast impenetrable jungles such as are hardly to be found elsewhere in India. Assam.

The Brahmaputra (under its Tibetan name of Tsan-po) spends about half of its total length in a hollow trough on the north of the Himālayas, between its birthplace near the eastern base of Kailās to its bend southwards towards Assam. It enters British territory under the name of the Dihāng near Sadiyā. After absorbing the waters of its two confluents, the Dibāng and the Luhit, the united stream takes the name of Brahmaputra (son of Brahmā, the Creator), and thenceforward rolls for 450 miles down the valley of Assam in a vast sheet of water, broken by numerous islands, and exhibiting the operations of land-making and encroachment on a gigantic scale. 'The mass of silt brought down from the Himālayas is sufficient to form mud-banks, and even islands, wherever it is arrested by any impediment in the current of the river, which thus constantly shifts its channel amidst an intricate network of water-ways. Broad divergent streams split off from the parent river, and rejoin it after a long separate existence of The Brahmaputra.

uncontrollable meandering.' The long-continued deposit of mud or silt has gradually lifted the level of the Brahmaputra channel above that of the surrounding flats; consequently a low strip of marsh and swamp immediately flanks the river bank on either side, which is submerged in times of flood. Beyond these swamps the ground rises gently to the foothills on either side of the valley. 'After leaving the Assam valley the Brahmaputra sweeps in a magnificent curve round the western spurs of the Gāro hills. Under the name of Jamunā it continues for 180 miles, nearly due south, to join the Ganges at Goalundo, where the two great deltas unite. Between their junction and the sea the united rivers receive fresh contributions from the eastern watershed between Bengal and Burma, through the channels of the Meghnā, which is itself a broad and imposing river. Unlike the Ganges and the Indus, the Brahmaputra is not utilized for irrigation; but its silt-charged overflow annually replenishes the adjoining land, which yields unfailing harvests of rice, oil seeds, jute, &c., in the flat plains of Eastern Bengal year after year without deterioration. The main river is navigable for 800 miles, from the sea to Dibrugarh; and nothing can be more picturesque than the crowd of quaintly rigged country craft, fashioned on lines that have survived from mediaeval ages, which crowd its broad flat surface [1].' Tea, timber, rubber, and cotton are carried down the current from Assam; jute, tobacco, oil seeds, rice, and other grains from Eastern Bengal. The total value of the river-borne trade of the Brahmaputra is probably not less than four millions sterling.

Such are, in general terms, the prevailing characteristics of the eastern extension of the great Indo-Gangetic depression which divides the Himālayas from the peninsular highlands. When we turn to the western arm, which forms the basin of the Indus and its affluents, we find physical characteristics that differ in many essential particulars from those we have described.

The Indus plain.

From the very commencement of the plains spreading southwards, the Punjab presents an aspect of flat treeless landscape, a broad grey sea expanding to a level horizon. There was a time when forests grew on the Indus—forests with timber sufficient to enable Alexander the Great to construct the first Indus flotilla; and about the valley of Peshāwar there were

[1] *The Indian Empire*, by Sir W. W. Hunter.

wide spaces of water-logged and swampy plain, amid the thick reed growths of which the rhinoceros and elephant had their home. Nor was this so very long ago; the skull of a rhinoceros has been found quite lately on the present ground surface. The deadly miasma of the swampy Peshāwar valley was as destructive 300 years B.C. as in the year of grace 1850. Happily within the last half-century science has shown the way to improved sanitation, and the climatic reputation of the Peshāwar valley has greatly improved. But the forests of the Punjab have long ago disappeared, and it is probable that with their disappearance the meteorological conditions of the Indus valley have greatly changed.

Nowadays the recorded rainfall is scanty (4 to 8 inches per annum in Sind, about the lower Indus), and the heat of the hot-weather months (April–July) is occasionally terrific. Monsoon-laden currents sweep up over Sind month after month, but no vapour is condensed in the hot dry air. No coast range about Karāchi faces the sea to send those currents circling aloft into the cooler strata of higher altitudes, where rain is made and the heavy atmosphere is deprived of its moisture. No part of the Indus valley is subject to a regular and systematic rainfall in the monsoon season, although the fall gradually increases from Sind upwards to Lahore. Neither can the frontier hills west of the Indus be said to lie under the influence of the south-west monsoon in spite of their altitude. Thus the climate of the Indus valley is hot and dry, and the vegetation which feeds on the reeking atmosphere of Bengal is entirely wanting. Tamarisk and other scrub fringes the river banks, and occasionally stretches outwards into something approaching forest dimensions. Irrigation has greatly developed lately; and there are green spots about the Indus river and the newly-spread network of the Punjab canals, which are once again slowly but surely altering the character of the landscape, if not of the climate.

The Indus river.

The Indus is about 1,800 miles in total length, and is more of a mountain-bred river than the Ganges. Even after it has left the Himālayas and wound its course across the eastern Peshāwar plain to Attock (where it is spanned by the railway bridge of the North-Western Railway system) it has not lost its characteristics of a gorge-enclosed river. It swirls down through deep rifts and clefts below Attock, parting the rugged spurs of the Punjab Salt Ranges ere it emerges into an open network of channels near the salt-built town of Kālābāgh, at least 200 miles from its Himālayan gates, and long after it

has received its frontier affluents, the Kābul and Kohāt rivers. The Indus is never really out of sight of the frontier mountains, although the thick haze which so frequently envelops the atmosphere of the Derajāt (the trans-Indus plains of the north) draws a dusty veil across the landscape; and its southward course from Kālābāgh is marked more frequently by desert sand-drifted spaces than by the green verdure of cultivation. The frontier stations below Kohāt form wet oases in a dry desert, and their humidity (born of excessive irrigation and consequent water-logging) frequently renders them unhealthy even in the midst of the desert air. The Indus builds up its bed, like the Brahmaputra, by the deposit of silt; and the gradually increasing elevation of its great silt-formed aqueduct is always a serious menace to the surrounding country, inasmuch as it leads to very extensive and very dangerous floods. The fall of the river from the Himālayas to the coast decreases from 50 inches to 5 inches per mile, and the lower reaches are subject (and have ever been so) to constant change of channel and a shifting of sandy bed. The two outer rivers of the Punjab (the Indus and the Sutlej), rising near each other beyond the Himālayan wall, enclose the Jhelum, the Chenāb, the Rāvi (the river of Lahore), and the Beās. Six centuries B.C. there was yet a seventh river of the Punjab—the Saraswatī, to the east of the Sutlej, of which tradition relates that, having ceased to join the Indus, it made for itself an underground connexion with the Ganges and Jumna near Allahābād. Over a vast space of the now desert country east of the Indus traces of ancient river beds testify to the gradual desiccation of a once fertile region; and throughout the deltaic flats of the Indus may still be seen old channels which once conducted its waters to the Rann of Cutch, giving life and prosperity to the past cities of the delta which have left no living records of the countless generations that once inhabited them. The history of the slow growth of the deltas of the Ganges and the Indus forms one of the most interesting chapters in geological investigation. It is at least clear that the Indus was not always shut off from the Peninsula of India by such wide spaces of desert as now form a formidable obstacle to progression from its banks eastward. Past generations of prehistoric immigrants, who crossed the frontier mountain barriers in successive waves to search for the golden plains, did not meet such obstruction to their slow movements

towards the east and south as would be encountered in these later days.

The Sutlej.

Of the living rivers of the Punjab, the Sutlej contributes most to the Indus. The Sutlej rises on the southern slopes of the Kailās mountain, the Elysium, or Siva's paradise, of Sanskrit literature. It once issued from the sacred lake of Mānasarowar, still the resort of nomadic Tibetan shepherds, who find among the surrounding stony flats pasturage for numerous flocks. Emerging from the Kailās foothills at a height of 15,200 feet above sea-level, the Sutlej first traverses a plain with a south-westerly course, cutting through a vast accumulation of alluvial deposits with a gully 4,000 feet deep. It then breaks through the Himālayas, between mountain ridges rising to 20,000 feet, and winds among the hills in a succession of rapids till it drops to 3,000 feet at Rāmpur, about 60 miles from Simla. Throughout its upper course the river is confined to the depths of a mountain trough, steep-sided and flanked by bare rocky precipices; hurling its turbid waters over its broken boulder bed with such terrific force as occasionally to grind into matchwood the huge balks of timber which it carries to the plains. Into these gloomy depths no human being can penetrate. By the time it reaches Bilāspur it has dropped to 1,000 feet above sea-level. After entering British territory the Sutlej receives the waters of the Western Punjab, and joins the Indus near Mithankot, after a course of 900 miles.

The Jhelum.

The Jhelum is the river of Kashmīr. Rising on the western slopes of the mountains which enclose the valley of Kashmīr on the east, the Jhelum follows the example of the Indus on the west, and of the Chenāb on the east, and winds with irregular and fantastic loops to the north-west before taking that final bend south which points the way to the Punjab plains. This course is determined in the case of all three rivers by the strike in the axis of the main Himālayan ranges, which is from north-west to south-east. It has already been noticed that the change of direction in the course of the Jhelum (when that river breaks through the mountain barriers near Bāramūla and rushes in a series of rapids and cataracts southward to the plains) has resulted in a silting-up of the alluvial plain above the constricted passage through the hills, and is the origin of the Happy Valley of Kashmīr. Similarly with the Indus and the Chenāb. The upper reaches of these rivers, where they drain comparatively narrow valleys between

stupendous mountains, present none of the wild magnificence of the seething cataracts of the lower reaches. The rivers flow placidly along, twisting and bending in folds, or sliding gently over gravel bottoms, till they pass the actual mountain gateways. In the Kashmīr valley the figures formed by the looping of the Jhelum have led to the traditional pattern that is typed in the shawls and carpets of the Kashmīr weavers. (Such at least is the belief of the Kashmīrī, although the cone is to be found in more ancient art.) Its poplar-shadowed breadths, moving gently and silently towards the Wular Lake, lapping the piles of the wooden bridges and the temple steps of Srīnagar, breathe the spirit of that poetic enchantment which ever broods over the country of Lalla Rookh. Below Bāramūla, to the point where it is joined by the Kishengangā—even beyond it—the scene is very different. A turgid flood sweeps downward over a rugged bed of boulders, shooting athwart them its green wavelets with smooth undulations and white frothy lips, or swirling into wild eddies and backwaters under the broken banks which enclose it.

The Chenāb.

Much the same characteristics pervade the Chenāb, so long as the Chenāb is a river of the mountains, following a course transverse to the general bend or strike of the mountain ridges. Both rivers, on emerging into the plains, assume a placid course, chequered only by sand and alluvial islets of their own construction, and ever shifting their channels from year to year.

The Rāvi.

Between the Chenāb and the Sutlej is the Rāvi, the source of which is sub-Himālayan, derived from the southern slopes of a range which overlooks the upper valley of the Chenāb. The Rāvi's claim to distinction is that on its banks stands the ancient city of Lahore, most famous of all the cities of the Punjab, and the objective of many a military expedition from Kābul.

The Beās.

The Beās river, which usually ranks as an affluent of the Sutlej, follows the rule of the rivers of the Punjab in taking a north-westerly course through the sub-Himālayan valleys from its source (not far removed from those of the Chenāb and the Rāvi on the western slopes of the Sutlej divide, overlooking Kotgarh, beyond Simla) to the bend through the outermost Himālayan foothills, which carries it south-west to its confluence with the Sutlej. There is remarkable uniformity in this characteristic of the Punjab rivers, which can be traced farther east in the mountain affluents of the Jumna and the Ganges, recalling that geological era when the

Indus carried with it the entire drainage of the Central Himālayan system.

The Punjab plain.

These living rivers of the Punjab, when once they reach the plains, pass through flat regions of interminable waste, where tamarisk scrub struggles for a foothold in the sandy soil, redeemed only by the verdure of the fringe of riverain, and the green patches due to recent irrigation. For the most part it is a region of ugly monotony. The level grey plains sink to no horizon. The yellow haze which permeates the atmosphere obscures distance, and contributes a prevailing tone of dreary drab to the landscape. The roads which traverse it are straight and narrow, paved with straw to keep down dust and sand, and the heat of the sun-glare (modified by haze) alternates with the bitter cold of the nights in winter. Through the midst of this flat land, the rivers roll down their mud-coloured flood in the snow-melting time of the Himālayas; or they wind in snaky twists about the floor of their wide beds, between banks which are ever changing, contributing new shoals and islands here and there, and shifting their channels yet farther and farther afield in uncontrollable vagary. Science has yet to devise a method of restraining the rivers of the Punjab.

The Indian desert.

The course of the Indus, from NE. to SW., is in striking parallelism to that of the oldest mountain range of India, the Arāvallis, which divides Rājputāna into two unequal parts. On the north-west lies the Thar, the great desert of India, which from time immemorial has proved to be a more effective barrier to the advance of armies than the Indus itself. Overlying this ancient bed of a great primaeval sea are ranged sand-dunes from 50 to 100 feet high, in systemated curves, moving in slow procession in obedience to the westerly winds. For 300 miles this desert extends between the Arāvallis and the Indus, arid, hot, and desolate, yet said to be bracing and wholesome beyond any other part of India. There is little vegetation, and what there is chiefly concentrates in the neighbourhood of the cities of the desert, Jaisalmer and Bīkaner. Only a single river bed of any importance is to be found in Western Rājputāna, that of the Lūni, which carries the drainage of the northern slopes of the Arāvallis into the nearest corner of the Rann of Cutch. On the northern edge of the desert, the arid character of the plains merges into the prevailing feature of scrub-covered wastes which is characteristic of so much of the Punjab. On the south-

west it is continued by the Thar and Pārkar sands of Sind. This vast open space of desiccated plain on the north-west of the Indian Peninsula terminates in the broad depression of the Rann of Cutch, flanked to the south by the hills of Gujarāt, which form the natural extension of the Arāvallis. Thus a wide region of depression is open to the vapour-bearing winds of the south-west monsoon, which sail through it and over it, unhindered by mountains, until they reach the Punjab. The Arāvallis may be said to divide the monsoon-washed area of the Peninsula southward from the dry regions of the Baluch frontier. So constant and unceasing is the steady sun-glare of the desert that a tradition (supported by a certain amount of evidence) relates that in days long anterior to the date of our introduction of the heliograph, bazar prices of wheat and grain in the Punjab were signalled by means of reflecting mirrors across Rājputāna to Sind and Bombay all the year round.

Southern Rājputāna.

That part of Rājputāna which lies south of the Arāvallis differs essentially from the Rājputāna of the north. Here we drop once again into the basin of the Ganges, for the Chambal river, with its Banās affluent, drains northward to the Jumna. It is in this part of Rājputāna that the great Rājput cities of the past are linked together—Jaipur, Ajmer, Udaipur, and Jodhpur; and it is here that the ancient Rājput dynasties rose to a position of pre-eminence among the dynasties of the continent. The sand-drifted landscapes of the northern reigions of Rājputāna are not wholly wanting to the south of the Arāvallis. Around Jaipur (itself set amid bright cultivation, and a centre of Indian art culture) broad sandy wastes reach to the foot of the rugged barren hills; they encompass the famous salt lake of Sāmbhar, white-edged with salt efflorescence and rose-tinted with pink crystals, where long sweeping lines of pink and white flamingoes make moving patterns on the sky as they circle in ordered companies. The atmosphere of Southern Rājputāna is still the sweet pure air of a dry desert; and the climate, with somewhat sharp extremes of temperature, is that which might well breed a race of men such as the heroes of their epics and the Rājputs of Indian history. Wind-blown sand always lies conspicuous on the northern slopes of the long straight lines of rocky ridge which, south of the Arāvallis for many a league, indicate the ancient existence of a yet wider

mountain system. Yet farther south and east, the desert aspects of Rājputāna are gradually lost, merged in the comparatively fertile forest-clad highlands of peninsular India. But it is the Arāvallis that mark the line of division. Beyond them to the north-west lie the Indus and the tertiary flats which the Indus divides. South of them are ancient red-sandstone strata of the continent, and a region of broad open valleys and gentle slopes, with rivers flowing in permanent channels, magnificent forests, a comparatively even rainfall, and temperate climate.

The Vindhya water-parting.

From the valley of the Ganges towards the south, India slopes gently upwards to a central transverse water-parting, which crosses the continent from west to east about the parallel of 23° N. lat., curving slightly where it follows the crest of the Vindhya hills, overlooking the deep narrow trough of the Narbadā river on the west, and breaking into irregularity where it parts the Ganges affluents from those of the Mahānadī on the east. The Vindhyas are the *rebord* or escarpment of the long gently shelving slopes of Central Indian territory. There is no steep fall, no well-marked spurs or steep-sided valleys, to the north of them. Southward, however, they slope abruptly from the crest to the Narbadā bed, shaping like a mountain wall buttressed by short forest-clad spurs, and presenting all the characteristics of a mountain range as seen from the river.

Central India.

The general lie of the Vindhyan strata is so nearly horizontal that throughout Central India there is one prevailing type of scenery. The sharp narrow-backed ridges of the Rājputāna border, following the strike of the Arāvallis, give place to broader flatter elevations, where the red-sandstone strata (formed, it may be, from the débris of the Arāvalli range) spread into nearly horizontal layers, with a gentle tilt southwards towards the Vindhyan water-parting. Here are straight lines of flat-topped hills and isolated synclinal folds, with deep-set ravines (locally known as *kho*), and the rivers occasionally run deep, with a network of intricate ravines interlacing their borders. Such well-marked hills as that which is surmounted by the rock fortress of Gwalior are rare, but they occur with less accentuated features farther south, and with a general tendency to scatter into isolated groups, leaving wide spaces of flat plain between. Forest areas are restricted in this part of the Peninsula, and their bounds are usually well defined. There is none of the interminable jungle of the Central Provinces farther east and south; the climate is for

the most part delightful in winter and tolerable in summer. The elevation of the plains rises to about 2,000 feet above sea-level, and the scenery amid the broken highlands is often magnificent.

The Central Provinces.

Eastward of the Central Indian States, but north of the central water-parting and still within the basin of the Ganges, the characteristics of the country change continually. The water-parting between the Narbadā and the Ganges lies close to the Narbadā river, restricting the valley to a narrow trough from its source at Amarkantak. From the Amarkantak *massif* the Son river takes its rise and runs north-east to the Ganges, and here too the upper affluents of the Mahānadī emerge outward and strike south-east for the Bay of Bengal. Between the two lies a broad tract of country, closely intersected with forest-covered hills on the west, but sinking into moist alluvial flats on the east (where it approaches the Gangetic delta), which is drained by several minor rivers, carrying their waters to the Bay of Bengal between the Hooghly channel of the Ganges and the Mahānadī.

The hilly district which culminates on the eastern edge of the Jubbulpore province (where the shrine at Amarkantak overlooks the sources of three great rivers) includes many remarkable topographical features. With a general tendency in the principal ranges to maintain a strike transverse to the meridian, they nevertheless present a most irregular structural conformation. Their broken outlines, piled upwards in apparent confusion—here stretching out into flattish forest-covered uplands, there breaking into rugged spurs dipping steeply down to the river edge—are highly picturesque; and the intervening folds of the rolling ruddy plains, dotted with tree clumps and spaced into park-like glades, are both typical and distinctive of Central Provinces scenery.

The Narbadā and the Tāpti (to the south of the Narbadā) together form a conspicuous exception to the general rule which governs the course of the rivers of the Peninsula, inasmuch as they flow westward, instead of eastward, in comparatively deep and narrow valleys to the Indian Ocean, dividing the sloping plains of the Vindhyan system from the Deccan traps and the plateaux of the central area. The two valleys are themselves separated by the Sātpurā hills, which range themselves in a well-defined thickly-forest-clad mountain fold from the central mass (culminating about Amarkantak) to the coast line above the Western Ghāts. A break in the continuity of this picturesque chain near Khandwā admits

of the passage of the railway connecting Jubbulpore with Bombay. South of the Tāpti river, throughout the Deccan and Madras, all the rivers of the Peninsula flow across the continent from west to east, rising in the slopes of the Western Ghāts.

The Narbadā.

Next to the Ganges, the Narbadā ranks as the most sacred river in India. Along its banks are erected shrines and temples innumerable, and tradition points to an age when it should even supersede the Ganges itself in the power of its sanctifying agency. The upper part of its course through the Central Provinces is confined within an exceptionally narrow and steeply enclosed valley, deep-set between the scarps of the Vindhyas on the north and the spurs of the Sātpurās on the south. Here the Narbadā is a magnificent stream of clear rushing water, breaking into cascades near its source, and leaping into falls where marble rocks enclose it below Jubbulpore; but after leaving the Central Provinces it widens to a mile or so in breadth, and courses placidly through the fertile flats of the Broach District of Bombay. Below the city of Broach it forms an estuary thirteen miles broad, the approach to the port being entirely dependent on tide. The Narbadā is navigable for country boats for about sixty miles of its lower course in flood time only; the upper reaches of the river are unnavigable and at the same time practically useless for irrigation.

Southern India.

South of the Tāpti river commences the Deccan, that striking physical feature which shapes the whole continent of India—the great three-cornered upheaval which, abutting on the line of the Western Ghāts, slopes with comparatively regular and easy grades to the step formed by the Eastern Ghāts overlooking the Bay of Bengal. Fringing this central sloping plateau on either side is a narrow strip of coast land, which comprises the lowlands of Bombay on the west and of Madras on the east. These lowlands form the India known to mediaeval tradition. It was on them that the foreigner, pushing forward his commercial interests, first set his foot; and the India known to the West for many centuries was but the narrow margin of fertile territory which lay below the feet of the mountains known as the Eastern and Western Ghāts.

The western coast.

There is naturally a considerable difference of physical aspect to be noticed between the low flat lands bordering the Indian Ocean to the north of the Narbadā and those of the long strip of Bombay coast to the south. When the

great prehistoric sea of Northern Rājputāna disappeared, there disappeared with it those climatic influences which once streaked Rājputāna with glaciers; but in later years the evidence of land formation has reasserted itself and is even yet in process of evolution. Where the sands of Rājputāna, shelving gently westward, merge into the flats of the Arabian Sea, we find the indefinite space of land and water called the Rann of Cutch, generally defined in our maps as a gulf or sea, with the island of Cutch standing in its midst and the peninsula of Kāthiāwār separating it from the shallow Gulf of Cambay. But the Rann is now chiefly dry land—a salt, barren, blinding waste of sand, where only the wild ass can thrive; and there is abundant evidence on all sides that it has been but lately developed and may again return to the sea. Kāthiāwār, with rising hills amid wide fertility, is an ancient land formation, possibly as old as the Arāvallis themselves; but north of Kāthiāwār, and south of it in the Bay of Cambay, as well as northward beyond Karāchi and on the Makrān coast, the process of silting (due partly to the influence of the south-west monsoon currents, and partly to the terrestrial action of rivers) is still proceeding apace, so that the general progression of land formation can be traced from year to year. The ceaseless action of the surf, slowly overcoming the resistance offered by a firm shore line (and aided possibly by a slow alteration in the level of the land surface), has here and there led to sea encroachment. The growth of the land seawards is neither universal nor unchecked. The western promontory of Kāthiāwār has yielded somewhat to the ocean, whose waves now beat on the steps of the temple at Dwārka; and there are traditions of islands farther south fringing the coast in the days when the slow fleet of Nearchus was piloted from the Indus mouth to Persia, which have altogether disappeared. But much of the land material thus effaced has been given back in the form of silt washed up in the fast-shallowing inlets and bays, and has contributed to the larger distribution of those deltaic areas which now extend for many square miles over spaces which have been sea within historic times. South of the Tāpti river along the length of the Bombay coast no very recent land growth is visible. The evidence of present configuration, confirmed by tradition, points to an ancient submergence of a vast extension of the continent on the west.

The Western Ghāts.

The great wall of the Western Ghāts probably represents the primaeval water-divide of the bygone Peninsula as it represents

that of to-day; but the upheaval to present altitudes must be comparatively recent, inasmuch as the steep-sided valleys of the rivers draining westward, and their tendency to deepen and reach back eastward at their sources, seem to testify to a yet unadjusted gradient. With a general elevation of 3,000 feet, the rugged outlines of the Western Ghāts are shaped into steep-sided cliffs and square-crested flat-topped peaks, which present a remarkable appearance. The weathering action of ages has shaped the trap formation into natural citadels and fortresses which dominate the crest of the hills, and were found most useful as military positions in the wild days of Marāthā supremacy. South of Bombay the seaward face of the hills is clothed with dense forest, and passes inland from the coast are few. But in the north the interior plateau is approached by several roads, famous in history, from the level coast strip on the western side. Of these the Borghāt is the best known, for where the railway now curls and twists around the spurs of a tremendous ravine to a height of 2,027 feet above the sea was once the military road which has ever been regarded as the key to the Deccan. It opened the way from the rising port of Bombay to the plains of India. The Thalghāt (1,912 feet) to the north-east of Bombay is another historic pass which likewise now carries a railway; and a third (almost equally celebrated) connects Belgaum with the little port of Vengurla. The precipitous square-cut peaks, which give such a fantastic appearance to the scenery of the Western Ghāts, are to be found wherever horizontal strata of varying degrees of resistance are subject to sub-aerial denudation. They repeat themselves in the Droogs of Deccan scenery.

The Konkan and Malabar.

The seaward face of the Western Ghāts is steep, a veritable 'landing stair' (*ghāt*) from the sea, and the intersecting valleys are filled with luxuriant vegetation, nourished by the sea-borne mists and vapours which condense upon the crest of the hills and stream down the steep-sided gullies in endless procession during the monsoon season. The narrow space of lowland bordering the sea below (from twenty to fifty miles wide) is much broken by spurs throughout the northern province of the Konkan, and in North Kanara the hills approach the sea very closely; but farther to the south they recede, leaving the fertile plains of South Kanara and Malabar comparatively open. In the District of Malabar the Western Ghāts merge into the irregular

uplands of the Nīlgiris, rising in altitude to 7,000 and 8,000 feet ere they drop suddenly to a remarkable gap (the Pālghāt Gap), through which the railway is now carried eastward from the coast port of Beypore.

The low-lying plains bordering the sea throughout the whole length of Western India, from the Kāthiāwār promontory to Cape Comorin, represented in mediaeval ages most of the wealth and strength of India, and are still noted for their great fertility. Ancient ports and factories (Arab, Portuguese, and Dutch) are to be found scattered along the coast line, and amid the palm groves of Malabar are many relics of the days when the commerce of the East centred on this coast. The long, firm, curved outline of the western sea-board south of Bombay is lost in Malabar. Here inlets and backwaters break across the dividing line of sea and shore, rendering the coast scenery impressively beautiful. Cascades plunge down the steep-sided cliffs into depths spanned by rainbows; and the deep stillness of primaeval forest encloses the clear reaches of the sea.

The Nīlgiris.

The physical aspects of the Nīlgiris and Anaimalais (repeated in the highlands of Ceylon) are remarkable for a certain roundness of outline and softened harmony of colouring which is wanting amid the sterner grandeur of the Himālayan mountains, or in the sharp exaggeration of steep-sided, square-crested peak and undulating forest which distinguishes the West. With a warm climate and a plentiful rainfall (80 to 100 inches) the abundance of natural flower growth allied to an indigenous sub-tropical vegetation is the glory of the Blue Hills (Nīlgiris) of the south. It is a characteristic which stiff rows of imported Australian trees (eucalyptus, wattle, and the like) have hardly yet displaced. The swelling grass downs of the plateau are parted by clear streams running in shallow channels, or by spaces of marshland and bog, bordering patches of indigenous forest, or *sholas*, which adjust themselves to the rounded contours of the hills. From the western peaks of the Nīlgiris the lowland sea of tumbled Wynaad hills may be seen stretching towards the blue waters of the Indian Ocean.

The Nīlgiri group forms the orographical apex of the Deccan highlands, which occupy a central triangular space of the Peninsula, bordered by the Bombay and Madras lowlands on the west and east respectively. Southward from the Nīlgiris, but separated from them by the well-defined Pālghāt Gap, the line of the Western Ghāts is continued

through the Anaimalai group by definite ranges to the southern point of the Peninsula; while detached masses of hills (the Palnis and the Salem hills), branching off to the north-east towards Madras, preserve the structural outlines of the continent south of the Deccan.

The Coromandel coast.

Between these southern hills and the eastern coast an expanse (100 miles in width) of lowland forms the richest section of the Madras Presidency. The heavy SW. monsoon rainfall of the Western Ghāts is unknown in the plains of Eastern Madras, but compensation is found in the NE. monsoon which usually succeeds the currents of the former. About 40 to 50 inches of rainfall form the average; and it is sufficient (with the addition of highly developed systems of irrigation) to ensure an almost inexhaustible fertility to the productive soil of these heat-laden districts. The lowlands of Madras are lands of palms, and of rice cultivation; of architectural development; of magnificent temples and decorative monuments of the Hindu faith; of busy centres of native culture and industry, where alone throughout the length and breadth of the continent evidences of a really indigenous art may be found.

The Eastern Ghāts.

Northward from Madras, curving slightly to follow the coast line, stretches a series of hills forming the eastern flank of the Deccan plateau, which are known as the Eastern Ghāts. They possess little of the magnificence gained by the regular structure but irregular outlines of the Ghāts of the west. They are scattered, broken, and of much inferior altitude; but there is geological evidence that they are but the denuded and depressed relics of a far higher and more distinguished mountain series, which may have been contemporary with the Arāvallis. They are certainly very ancient. They may be traced northward at varying distances from the coast (averaging about 50 miles from crest to shore line, but occasionally throwing off spurs which break the coast into headlands) till they join with the transverse water-divide which parts the rivers of the Deccan from the Narbadā and Mahānadī basins. The physical characteristics of all that strip of territory which includes the maritime districts of Madras vary but little between the Mahānadī basin and Cape Comorin. Everywhere there is the same humid and enervating atmosphere, but faintly relieved by the freshness of the sea; the same narrow strip of sandy foreshore, leading up to a wide vista of green rice crops and palm growth; the same background of forest-clad hills, now receding into

the misty distance, now breaking the dead monotony of the surf-bound coast with bold bleak headlands. At intervals there occur broken edges in this ancient coast-line, where large lagoons or lakes range themselves in a formation not unlike that of the backwaters of Malabar. Whenever the delta of a great river occurs, there reaches out seaward a wide expanse of banks and shallows which render a close approach to the coast ports impossible to ships of any size. When no such silt-formations exist, the open roadstead usually affords fair and close anchorage (as at Madras and Vizagapatam), but on the whole the east coast of India is singularly deficient in natural harbours. From the deck of a coasting steamer at anchor off Masulipatam a far-away line of nodding palms is frequently all that may be seen to indicate the existence of land.

On the west of India the long line of maritime territory stretching between the Ghāts and the sea is unbroken by the passage of any considerable river south of the Tāpti. But on the eastern coast we have in succession all the rivers of Central and Southern India, which, rising almost within sight of the western coast, break through the line of Eastern Ghāts and form wide fertile deltas, which are the granaries of the Peninsula. The deltas of the Godāvari, the Kistna, and the Cauvery together form the most remarkable feature in the economic geography of Madras; and to the north of them the Mahānadī intervenes with another system of deltaic irrigation which adds to the wealth of Lower Bengal.

The Deccan.

The term Deccan (Dakshīn, the 'right hand' or 'south') in its political application comprises the highlands filling the triangular space south of the central transverse watershed, and within the crest-line of the Eastern and Western Ghāts which buttress it on either side. Shelving gradually from west to east, it is generally an area of open valleys and broad plains, broken by the fantastic outlines of the Western Ghāts and their outliers; extensively cultivated within the States of Hyderābād and Mysore, but covered with primaeval forests to the east of the Godāvari, where it stretches in gentle grades to the crests of the Eastern Ghāts.

The two great river basins of the Godāvari and the Kistna nearly divide the Deccan highlands between them. The Cauvery is a third river of the Deccan which has its sources in the Western Ghāts to the north-west of Mysore, close to those of the Tungabhadra, the chief southern affluent of

the Kistna. The basin of the Penner also (a comparatively small river which reaches the Bay of Bengal near Nellore) includes a part of the Deccan highlands. The small streams and rivulets which, emerging from the embrace of the eastern slopes of the Ghāts, unite to form these rivers as they gradually pursue an uneventful course through the shelving flats of the Deccan, pass through districts which are almost monotonously similar in their physical characteristics. The magnificent peaks and precipices and broken outlines of the western mountains merge gently into wide rust-coloured plains, streaked and dotted with outlying hills of bold configuration, which still preserve a physical likeness and relation to each other. The intervening spaces are bare in patches, or covered with an intermittent growth of somewhat stunted forest, save where the black soil (locally known as 'cotton' soil) prevails near the rivers, until gradually the river-flow becomes more abundant, and irrigation adds fertility and agricultural freshness to the landscape. There is no soil in India more productive than the black cotton soil of its central highlands. In the gneissic regions of the Deccan, the plains are frequently starred and dotted by granite tors and bosses, sometimes of immense size, which introduce a local character to the aspect of the country that is entirely typical of India. The rock of Trichinopoly; the great carved bull of the Chāmundi hill in Mysore; the Madan Mahal in Jubbulpore, where a palace surmounts a rounded mass of granite, are all famous and are all typical.

As the great rivers, gathering force, flow eastward and southward, the arid wind-swept plains give place to a more general growth of jungle, and immediately approaching the Eastern Ghāts the forest thickens greatly. Indian forests.

Indian forest, which is perhaps the most generally prevalent of all its physical aspects, varies very much in different parts of the continent. In the north and north-east of India the Tarai forest below the Himālayas largely consists of huge trees set in a thick mass of almost impenetrable vegetation, with a rank growth of grasses and reeds interspersed. The trees are often of gigantic size, and tufted bamboos interlace beneath their widespread arms, reducing daylight to twilight, and leaving but the narrow paths and tracks of wild animals open to living movement in their midst. Where elephants and buffaloes have not forced a way, it is frequently impossible to traverse these forests at all.

Some of the denser forests of the west coast almost rival

rich cultivation, no less than twelve irrigation dams having been constructed to intercept its flow. Within the limit of this State it encloses the two sacred islands of Seringapatam and Sivasamudram. Around the latter are the celebrated falls, the river branching into two channels, each of which descends about 300 feet in a series of cascades and rapids. The scenery of this part of the river course is unrivalled for romantic beauty.

Three minor rivers—the Penner (the river of Nellore), the Pālār (south of Madras), and the Vaigai (the river of Madura)—all contribute to the alluvial wealth of the maritime districts of Madras. The chief physical characteristic of all Eastern India is its deltaic wealth and agricultural abundance. Here swarms an indolent rice-eating population, which contributes as little to the strength of the Empire as the eastern districts of Bengal. A moist, humid atmosphere, easy abundance of food, and a generally enervating climate, all tell against physical development; although there are yet communities in Madras which can boast of a martial population with traditions of the Carnatic and Marāthā wars still stirring their veins.

The extreme south.

In the extreme south of India the Districts of Tinnevelly and Madura, shut off from the western maritime State of Travancore by the granite ranges of the Southern Ghāts, present a distinct feature in Indian physiography. They consist mostly of open treeless plains sloping gently eastwards to the sea, with long spurs and outliers reaching north-eastwards about the sources of the Vaigai, but southwards, where the mountains rise to 4,000 feet in height, they throw off no spurs whatever. Isolated hills and masses of rock are scattered about the broad red plains, with a little cultivation near the river banks. Groves of palmyra and coco-nut flourish near the coast and along the river banks, but the general appearance of the country is one of dry, red desolation. The coast line is broken by shoals, and rocks, and reefs, with many evidences of the recent submergence which has separated Ceylon from the mainland. It is a curious feature in Indian physiography that so great a difference should mark the aspect of this part of India (the early centre of Dravidian occupation and development) and Ceylon, which is so near it.

Travancore.

Travancore, on the other hand, is one of the most picturesque portions of Southern India. The Ghāts, covered with magnificent primaeval forest, throw out spurs to the western coast. The whole country is undulating, and the narrow strip of

lowland facing the ocean is one unbroken mass of coco-nut and areca palms. The coast is patched with lagoons and backwaters, the latter forming a line of inland water communication for nearly the whole length of the State. The abundant rainfall is answerable for effects of climate and scenery which (unlike Tinnevelly and Madura) find their parallel in the southern island.

Separated from India politically as a Crown colony, Ceylon, the 'utmost Indian isle,' cannot be dissociated from the Peninsula, with which it is so nearly connected by Adam's Bridge and the island of Rāmeswaram. The rocks and shoals which beset the narrow sea between the Indian coast and Ceylon are passable by two narrow passages: one, known as the Manaar, is only navigable by small boats; the other, the Pāmban, admits of vessels drawing 10 feet. Ceylon appears to have been for ages slowly rising from the sea, the extension of the northern flats about Jaffna being quite recent—probably formed partly by accumulation of detritus washed down by strong southern currents from the Coromandel coast and piled on to the coral reefs around Point Pedro. From the central mountain zone outwards there extends a broad fringe of plain, which varies in width from 30 to 80 miles in the southern parts of the island, but occupies very nearly half of its area in the north. The mountains group themselves into fantastic peaks and prominences about the centre of the island; but, irregular as is their apparent configuration, there is a distinct tendency to a north-east to south-west strike about the main ridges of them. The highest peak, Pidurutalaga, dominates the mass from an altitude of 8,300 feet; but the sharply defined Adam's Peak, overlooking the sacred footprints of Siva, of Buddha, or of St. Thomas (according to the faith of the devout pilgrim to the shrine), is better known. Detached hills are rare, the most famous being Mahintale near the ancient Buddhist city of Anuradhapura; and Siguri, which is very similar to those detached and steeply scarped isolated hills of the Deccan which have so frequently been converted into Marāthā strongholds. Except for the clearings of plantation and agriculture the whole island is jungle-covered. The northern half of it is a vast expanse of primaeval forest, traversed by the great high road of the north, with its branches to the ports of the eastern coast. Forests have closed in, around, and over the site of the great Buddhist cities, which

Ceylon.

are as yet but partially explored. Ancient images of Buddha sit in eternal contemplation of the recurrent processes of decay and regeneration in the shadowy depths of the ever-thickening jungle. Twenty feet below the present level of the land surface are found architectural evidences of a faith which founded them less than 2,000 years ago.

The coast-line of Ceylon is singularly beautiful. Fringed with palm trees down to the very water's edge, the long line of yellow foreshore is broken at frequent intervals by the picturesque villages of a fishing population, which seems to swarm in every sheltered bay and backwater. On the east and south the coast is low, and the surf beats with long monotonous cadence on the sands. On the east some of the luxuriance of vegetation is wanting, but the coast breaks into bold headlands, cliffs, and precipices, and deep soundings are found close to the shore. The harbour of Trincomalee (famous in the history of our naval conflicts with the French in eastern seas) is celebrated as one of the most beautiful in the world, ranking with Sydney or Rio Janeiro. The well-known ports of the west coast, those of Colombo and Point de Galle, are picturesque, by reason both of natural situation and artificial development. The quaint old Dutch towns which overlook them, full of life and colour, seem specially adapted to match the natural environment of deep green vegetation flanking smooth-spreading grass flats, interlaced by the ruddy roads or brightened by sparkling lakelets. No measured language can express the beauties of Ceylon scenery. From Colombo to Kandy, where a lake set in the hills reflects the visions of palms and temples, and the many-coloured array of native buildings below the long slopes of the shadowing mountains; and from Kandy to Nuwara Elia, where the softer and gentler beauty of the Nīlgiris is repeated in rounded slopes and lakes and patches of indigenous *sholas* amid the mountains, there are endless vistas of transcendent beauty. The rivers of Ceylon (of which the chief is the Mahaveli Gangā), while yet collecting their mountain affluents, rush downwards through glens and ravines, and fall in cascades to shaded forest depths, circling and winding under the curved arms of magnificent bamboos, breaking into cataracts and rapids, and finally sliding in broad level reaches across the flats and sands of the maritime lowlands. The roads of Ceylon pass through long avenues of pepper-festooned palm trees, backed (but for the narrow spaces of cultivation) with black depths of primaeval jungle. They are

full of life and colour, derived from the flights of myriad butterflies which fill the air with gaudy glitter, and the gaily-dressed Tamil people who gather in bunches on the banks of the great four-sided Buddhist tanks absorbed in eternal gossip. The clear spaces of Ceylon are to be found in the plantations of cocoa, coffee or tea, or in the midst of the rice-fields. Cocoa cultivation favours a growth of shade trees, and a cocoa estate therefore presents a natural charm sometimes wanting in the stiff lines of tea cultivation, which cover the undulating hills up to an altitude of about 6,000 feet as with a dark-green vestment. Since the failure of coffee, tea plantations have become the prominent feature in Singhalese mountain landscape.

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CHAPTER II

GEOLOGY

I. Introduction

Peninsular and extra-peninsular India.

To those who support as well as to those who deny the doctrine of the permanence of oceanic basins and continental plateaux, India, the land of paradoxes, provides striking illustrations of these diametrically opposed opinions, a circumstance which suggests that the real truth lies somewhere between the extreme positions taken up by two classes of equally sincere naturalists. Those who think that the main orographical features originally developed on the solidified crust have never been seriously modified recognize in the main Peninsula an example of solid land which has neither been folded nor disturbed since the earliest geological times. Those who hesitate to recognize any limits to the mobility of the earth's crust quote the Himālayas as an example of an area in which marine deposits containing Nummulites, and therefore no older than the London Clay, have been raised to an elevation of 20,000 feet within the Tertiary period.

Within the limits of the Indian Empire we have, therefore, two utterly dissimilar areas, unlike in geological history and equally unlike in the physical features which are the direct outcome of the geological past. In the Peninsula we have one of the few masses of land which have withstood all tendencies to earth-folding for as long as the palaeontological record stretches back. In the Himālayan region, on the other hand, the folding of the crust has produced, during the latest geological epoch, the grandest of our mountain ranges.

The stable Peninsula.

Except in marginal strips which show temporary and local trespasses of the sea on the coast, not a single marine fossil is found throughout the whole extent of peninsular India. The orographical features of this area are the outcome of the differential erosion of an old land surface, where the shallow

open valleys, with rivers near their base-level of erosion, and the gently undulating plains are due to the toning down of the rocks by long exposure to the weather.

The folded extra-peninsular area.

A very different state of things is disclosed in the land lying to the west, north, and east of the great Indo-Gangetic alluvial belt: in Sind, Baluchistān, the Himālayan belt, Assam, and Burma we have abundant evidence of repeated immersions beneath the ocean. In this area the directions of the mountain chains are determined by comparatively young rock-folds, while the region having been but lately elevated, its rivers are swift and torrential, cutting down their beds so rapidly that the valley sides are steep, with loosened material, always ready to slide off in destructive landslips.

Correlation of Indian strata with the European scale.

In attempting to express these two distinct geological stories in European terminology we find that our simplest and most easily translated characters are preserved in the marine fossiliferous strata, while it is practically impossible to correlate directly the land and fresh-water formations which are so largely developed on the Peninsula with their equivalent stages in the European standard scale.

Variable rate of evolution in isolated land areas.

The reasons for this contrast are simple. Conditions of life are much more uniform, and facilities for migration much more perfect, in the ocean than on land. On land areas there is a greater variety of physical features, and a greater diversity, therefore, of climate and other conditions which affect the distribution of living beings. Consequently, when such areas are cut off from one another by impassable physical barriers, the intermingling of plants and animals is prevented, and evolution proceeds at independent rates in the separated areas, attaining corresponding stages at quite different times. As an example of the errors which would arise if we compared the fresh-water and land fossils of widely separate areas with one another, we have, in the existing indigenous mammalian fauna of the isolated Australian continent, a stage of evolution about equivalent to that which characterized Europe in Jurassic times. This want of correspondence during the same period of living forms in widely-separated land areas is one of great importance to the Indian geologist, who has had the point most strikingly brought home to him in his attempt to determine the age of the great coal-bearing system in India. The luxuriant growths of ferns, horsetails, cycads, and conifers which flourished in the great river-valleys of the old Gondwāna continent did not make their appearance in Europe until well on in the Mesozoic era, yet, from other evidence, we know

that the lowest coal measures in India were being formed during Upper Palaeozoic times.

Comparative uniformity of life in the ocean.

On the other hand, among marine fossils, especially such freely migrating forms as cephalopods, we have in general a tendency to wide geographical distribution with a very limited vertical range. The recognition, therefore, of the species of marine fossils in Indian formations permits a more precise correlation of Indian strata with those of Europe than is possible in the case of the fresh-water strata. The marine formations enable us to fix the chief landmarks in Indian geological history, and, having established these, we can consider the associated fresh-water and unfossiliferous rocks.

Want of strict contemporaneity in geological formation.

Before settling down to the description of the Indian rocks, there is one more stratigraphical principle of which the reader should be reminded: it is necessary to explain how it is that, in our attempts to express Indian stratigraphy in European terminology, we never attain full success.

In consequence of the way in which most areas have been alternately immersed below the sea to receive deposits of sediment, and raised to the denuding action of atmospheric agents, the sedimentary record in any country is marked by interruptions at irregular intervals in the scale. These interruptions or 'breaks' are not on the same horizons for all parts of a large area, for one part may be below water and receiving sediment when another is exposed and being cut into by the weather. Thus the dominant breaks in the Indian stratigraphical scale can only by an infinitesimal chance be strictly contemporaneous with those in Europe. In employing such breaks in the succession to define the upper and lower limits of stratigraphical units, we obtain series of strata which cannot correspond precisely to the units in the European scale; and for these series we are driven, therefore, to employ, in the first instance, local names which may cover parts of two or more European units. In Southern India, for instance, we have a series of strata answering generally to the Upper Cretaceous of Europe; but the four natural subdivisions in India do not correspond precisely with the European subdivisions. The lower part of the Utatūr stage of Southern India corresponds to the cenomanian of Europe, while its uppermost beds contain a turonian fauna. The lower beds of the next succeeding stage, the Trichinopoly beds, are turonian, while its higher beds are senonian (see Bibliography, paper No. **1**[1]). This circumstance,

Use of local stratigraphical names.

[1] Figures in parentheses and printed in antique type refer to the papers quoted in the Bibliography at the end of the chapter.

which increases the difficulties of correlation, is no more than one expects from the teaching of physical geography. The changes which occur during the processes of sedimentation are local: one area is receiving the fine *detritus* carried out by a large river, another is covered with sand brought down by a swifter stream, while a third is being buried in foraminiferal ooze, or supports a coral reef in the deeper and clearer water of the ocean. All have their characteristic forms of life, and these differ again, in both lithology and fossil-contents, from the beds produced contemporaneously in lakes and river-valleys. The commencement and end of sediment in one area do not coincide with those in another; and, as a final difficulty in the way of precise correlation over large areas, many animals migrate from one region to another, their remains being found in one area and those of their descendants in another at a higher horizon in the stratigraphical scale. When the reader, therefore, finds the Indian geologist hesitating over the naming of his stratigraphical systems in India, he should remember that the hesitation is not due always to imperfect knowledge, but to consciousness of the fact that no unit in the stratigraphical formations of India corresponds exactly with the stages defined in the European scale. Nevertheless, our nearest approach to precision in correlation will be among the marine formations, and these, consequently, are used as reference horizons in our attempt to express the data of Indian geological history in terms familiar to European students.

Classification of Indian strata. The datum line in stratigraphy.

The datum line in stratigraphy is the base of the Cambrian system, the so-called *Olenellus* zone, characterized in various parts of the world by remains of this genus, or its near relations, belonging to the extinct order of Crustacea known as trilobites. Below this line there are many thousand feet of strata without determinable fossil remains, and generally quite unfossiliferous; above it are piled the great fossil-bearing systems preserving the records of evolution among animals and plants through the Palaeozoic, Mesozoic, and Cainozoic eras to the present day.

The Olenellus zone.

Fortunately in India we have a trace of this datum line preserved in the Salt Range of the Punjab, where, although the Trilobites preserved are not exactly like the well-known *Olenellus*, there are forms which must have been close relations of it, and we can safely assume that these beds, referred to in more detail below as the *Neobolus* beds, are equivalent to the Lower Cambrian of the European scale.

Pre-Cambrian unfossiliferous rocks.

To the ages preceding the date at which the *Neobolus* beds were formed we refer :—

(*a*) The great mass of crystalline schists which are exposed over half the Peninsula, forming the old floor on which the unaltered sediments were laid down ;

(*b*) The great thicknesses of unfossiliferous strata known by such local names as Gwaliors, Cuddapahs, and Vindhyans.

Fossiliferous deposits.

The ages following the Lower Cambrian period have left their records in India in two groups :—

(*c*) During the Palaeozoic era deposits were formed in the extra-peninsular area with fossil remains referable to one or other of the well-known systems of Europe from the Cambrian to the Carboniferous. No records of this era have been preserved on the Peninsula.

(*d*) From Permo-Carboniferous times to the present day we have a double history: a record of life and events on the stable Peninsula, and a series of deposits formed in the adjoining ocean whose bed was afterwards upheaved to constitute the extra-peninsular parts of India.

Four resultant main groups.

Indian rocks thus fall naturally into four great groups: two below the *Olenellus* datum line without fossils, and two above the horizon at which the oldest recognizable fossils occur. The arrangement and chief divisions of these four groups are shown in the accompanying table (p. 55).

Archaean group.

The oldest is a group of highly folded and foliated, immeasurably old, crystalline schists, gneisses, and plutonic rocks having the typical characters of the *Archaean* group of Europe and America, with which they can be correlated with sufficient safety to warrant the employment of the same group name.

Purāna group.

The next is a great group of unfossiliferous strata lying with marked unconformity on the Archaean gneisses and schists, separated from the latter by a great physical 'break,' which is unmistakable throughout the Peninsula. This group is here distinguished as the *Purāna* (old), and it includes such isolated systems as the Cuddapahs, the Gwaliors, and the Vindhyans in the Peninsula—rocks which are sometimes locally folded, but never foliated, and often practically undisturbed. To what extent the Purāna group is represented in the unfossiliferous systems of the outer Himālayas it is impossible to say ; for the only correlation data being lithological, the records have been mutilated by the folding of the Himālayan range. This group corresponds to much of what in America has been known as the Algonkian—rocks which lie between the base of the fossiliferous Cambrian

		Marine formations.	Fresh-water formations.	Approximate age in European and American equivalents.	
FOSSILIFEROUS.	ARYAN GROUP.	Raised beaches; coral banks	Recent alluvium; Porbandar stone; Desert sand.	Recent } Post Tertiary.	CAINOZOIC.
		Cuddalore sandstones	Older alluvium of Narbadā and Godāvari.	Pleistocene	
		Makrān series	Upper Siwāliks, Irrawaddy series	Pliocene } Tertiary.	
		Gāj, Yenangyaung, and Prome series	Lower Manchhar	Miocene	
		Nāri	Kasauli	Oligocene	
		Kīrthar, Rānīkot, Sabāthu	. . . .	Eocene	
		Cardita beaumonti beds	Deccan Trap }	Cretaceous	MESOZOIC.
		Chikkim series; Bāgh beds; Ariyalūr, Trichinopoly, and Utatūr beds.	Lameta series }		
		Spiti shales; massive limestone of Baluchistān; Umia. }	Jubbulpore series }	Jurassic	
		Katrol, Chāri, and Patcham series of Cutch; Hsīpaw series. }	Rājmahāl and Mahādeva series. }		
		Trias of Central Himālayas; Ceratite formations of Salt Range.	Pānchet series Gondwāna system.	Triassic	
		Productus shales and limestones, Central Himālayas and Salt Range.	Dāmuda series		PALAEOZOIC.
		Boulder-bed of Salt Range	Tālcher boulder-bed	Permian	
	DRAVIDIAN GROUP.	*Upper Palaeozoic unconformity.*			
		Fenestella shales of Central Himālayas; Zewān beds of Kashmīr; Limestones, &c., in Burma		Carboniferous	
		Chitrāl limestones, Maymyo limestones		Devonian	
		Silurian of Central Himālayas and Upper Burma	Fresh-water formations unknown between the base of the Gondwānas and the uppermost Vindhyans.	Gothlandian (Silurian)	
		Haimantas in part of Central Himālayas		Ordovician	
		Neobolus bed and associated Cambrian in the Salt Range.		} Cambrian	
		Olenellus zone or base of the Cambrian system			
UNFOSSILIFEROUS.	PURANA GROUP.	Vindhyans, Kurnools, Upper Cuddapahs, Kalādgis, Pakhals, Bhīmas		Keweenawan	ALGONKIAN.
		Lower Cuddapahs, Gwaliors, Bijāwars, and Pengangā series		Animikie	
	ARCHAEAN GROUP.	*Great Eparchaean interval.*			
		Dhārwārian		Huronian	ARCHAEAN.
		Eruptive gneisses and granites: charnockites and norites of Southern India; anorthosites of Bengal.		Laurentian	
		Schistose gneisses, often with intruded pegmatites like those of the mica-mining areas		Keewatin	
		Oldest gneisses		Coutchiching	

and the eroded edges of the Archaean schists. Whether the younger stages of the Purāna group were formed before Cambrian times is not known; for on the Peninsula, where the Upper Vindhyans are the youngest strata in the Purāna group, they come into relation with no fossiliferous rocks older than the Permo-Carboniferous of Europe.

Grouping of the fossiliferous strata.

The nomenclature and grouping of the fossiliferous strata require explanation. In Europe the corresponding fossiliferous scale is divided very unequally into the Palaeozoic, Mesozoic, and Cainozoic groups, the inferior and superior limits being fixed at positions showing pronounced physical and palaeontological 'breaks.' As the evolution of animals and plants has been continuous since life first appeared on the earth, palaeontological breaks have obviously only a local significance, and the chief gaps in the European scale do not correspond to those which are noticeable in Indian strata. If the scale had been divided into groups according to Indian data, the lowest group would have its superior limit at an horizon corresponding approximately to the Permo-Carboniferous of Europe, for at about this stage there was a pronounced revolution in the physical features of the Indian area. The second stage would commence with the conglomerate which was formed in a period of great cold, giving rise to ice-sheets which have left their marks in a boulder-bed below the Productus limestone formation of the Punjab Salt Range, and in the Tālcher series which forms the lowest stage of the great coal-bearing Gondwāna system. There is no break at a higher stage so pronounced and widespread as this Upper Palaeozoic gap. Local changes in the physical geography of the extra-peninsular area are recorded in many localities, but there is a fairly continuous history of evolution from the time when the remarkable brachiopod *Productus* invaded the Indian seas to the coral banks and oyster beds of modern times. The Indian fossiliferous strata thus fall naturally into two great groups which are approximately equal in value. The lower and older group, which may be conveniently distinguished as the *Dravidian*, is about equivalent to that portion of the European Palaeozoic which includes the Cambrian, Ordovician, Silurian, Devonian, and Carboniferous systems; while the upper and younger, distinguished as the *Aryan* group, includes all strata from the Permo-Carboniferous system to the present day.

The Upper Palaeozoic break.

Dravidian and Aryan groups.

There is no trace of any fossiliferous strata on the Peninsula of India which can be referred to the Dravidian group; and such unfossiliferous strata as the Cuddapah and Vindhyan systems are,

in the absence of fossil evidence, grouped with the Purāna strata, and regarded as more ancient than the Cambrian. In the extra-peninsular area we have members of the Dravidian group in the Salt Range, where there are strata of about the same age as the Cambrian of Europe; in the Central Himālayas, where Cambrian, Silurian, Devonian, and Carboniferous rocks are preserved; and in Burma, where representatives of the Silurian and Devonian have been definitely recognized by characteristic fossils.

The Dravidian group in extra-peninsular India.

The younger or Aryan group is represented on the Peninsula by the great fresh-water Gondwāna system, which was followed by marginal encroachments of the sea in Upper Jurassic and Lower Cretaceous times; and by the deposition of subaerial and lacustrine formations in the Upper Cretaceous, with the great outflow of basic lava, covering the Deccan by volcanic eruptions, which continued until the commencement of the Tertiary period.

Fresh-water deposits in the Aryan group.

In the extra-peninsular area there is a great development of fossiliferous rocks, ranging through Permian, Mesozoic, and Tertiary times. Most of these are of marine origin, for the great central sea, Tethys, extended from Europe over most of this area throughout the Mesozoic era. It was only in the Tertiary period that the Himālayan region emerged and gradually drove back the ocean, until, in miocene times, it was restricted to Baluchistān on one side and Burma on the other. It was driven back still farther in pliocene times, when the mastodon and other mammals now extinct roamed through the jungles of Burma and the Himālayan foothills, leaving their bones to be buried in the rapidly accumulating river sands.

Marine deposits in the Aryan group.

II. Pre-Cambrian History of India

In dealing with the unfossiliferous rocks formed in pre-Cambrian times, the geologist is in a predicament similar to that in which the historian finds himself when dealing with legendary periods for which no written records exist. The subject demands either a full description of the numerous difficulties which arise from want of precise data, or the briefest of statements consistent with the paucity of definite conclusions to which the geologist is able to point.

In the pre-Cambrian history of India there are two great and well-marked divisions, the records of the Archaean being immeasurably older than those of the Purāna era. Among the Archaean group are rocks which were presumably formed by

The Archaean and Purāna eras in the pre-Cam-

brian history of India.

the ordinary processes of mechanical sedimentation, yet after their formation there was time enough for them to be folded into great mountain ranges, and then cut down to a base-level of erosion, before the Purāna sediments were laid down on their upturned and denuded edges.

The great Eparchaean break.

What this 'break' represents in the geological time-scale we have not the slightest idea; but it is probably no exaggeration to say that the lapse of time since *Olenellus* flourished in the Cambrian seas is small compared with that between the formation of the lava-flows which are now folded up in the Kolār goldfield, and the deposition of the basement sediments of the Cuddapah area. In gauging geological time the intervals of no record are as important as those of continuous sedimentation; and if there is one break in stratigraphical history that is universal, it is this which cuts off the Archaean crystalline schists from all subsequent rock groups. This *Eparchaean interval* in peninsular India is as well marked as it is in the Great Lakes region of North America, both areas having escaped folding movements since the deposition of the old unfossiliferous rocks. In these two areas, therefore, the circumstance of foliation alone is sufficient to mark off the Archaean from the Purāna group. But in areas which have been highly disturbed since Purāna times the old and the very old rocks have all been foliated, and it is now impossible to distinguish one from another. This summary permits only of brief reference to the chief characters of the two great groups, which are here taken in order of age.

Archaean era.
Area of the Archaean rocks.

More than half the area of the Peninsula is occupied by exposures of the old crystalline rocks, which must have obtained their present characters at great depths, being afterwards exposed to the surface by denudation of the superficial rocks. The crystalline rocks now exposed at the surface form only a fraction of the whole, for large areas are covered by the mantle of younger sediments and lava-flows; and it is in consequence of its position with regard to the ordinary sedimentary rocks that the old crystalline group is sometimes spoken of as the 'fundamental complex.'

Origin and nature of the fundamental complex.

The fundamental complex in India agrees in essential respects with that of other countries, for instance America, where this group, on account of its great age—greater than that of any known fossiliferous rocks—was first named Archaean. Some of the rocks forming this complex are masses of deep-seated igneous origin; others presumably originated as sandstones, shales, limestones, lava-flows, and other forms of superficial

deposits, which became metamorphosed by close-folding, by depression to great depths in the crust, and by further injection of igneous material.

Ortho-gneisses and para-gneisses.

In some cases the gneisses and schists present so markedly the chemical and mineralogical characters of igneous rocks that one does not hesitate to regard them as merely plutonic masses deformed by pressure and movement. These are often spoken of as 'orthogneisses' and 'orthoschists.' Others retain the essential chemical characters of well-known sediments, and differ from them merely in mineral character and texture due to metamorphism. These are known as 'paragneisses' and 'paraschists.'

Mixed gneisses.

But there is a considerable fraction of the Archaean group in India, as elsewhere, whose precise origin is doubtful: some of these indeed appear to be the result of the intimate mingling of igneous injections and pre-existing rocks.

Chief divisions of the Archaean group.

The Archaean group in India may thus be divided conveniently as follows:—

4. Dhārwārian.

Eruptive Unconformity.

3. Granites of Bihār ('dome-gneiss'), granites of North Arcot in Southern India, anorthosites of Bengal, charnockite series of the Madras Presidency, norites of Coorg, pegmatites, &c.
2. Schistose and
1. Gneissose rocks.

Among the gneisses and schists it is practically impossible to distinguish a succession in time, even locally; and we are reduced to a system of classification which separates the distinctly eruptive types from those of doubtful origin, and from the masses in which there are signs of the commingling of eruptive and probably sedimentary material in a way far too intimate for differentiation. The following main divisions represent the chief types noticeable in the field:—

(1) Well-banded gneisses and schists, among which are alternations of bands of dissimilar lithological types, presenting the characters which one would expect from the metamorphism of a formation consisting of shales, sandstones, limestones, and lava-flows. The areas in which the mica-bearing pegmatites of Nellore and Hazāribāgh occur form good illustrations of this division of the Archaean group (**2**).

(2) More massive gneisses, such as might result from the more complete metamorphism of group (1), and the inclusion

of more eruptive material which has absorbed and become intimately mixed with the pre-existing rocks.

(3) Definite eruptive types, deformed by earth pressures, with a foliation structure often in conformity with the associated gneisses and schists of groups (1) and (2). The rocks of this group generally show a family character over considerable areas. As examples we have the elaeolite-syenites and associated rocks of Coimbatore (**3**), the great granite masses of North Arcot and Salem, the norites of Coorg, the anorthosites of Bengal, the charnockite series which forms the larger hill masses in Southern India (**4**), and the so-called 'dome-gneiss' which rises as bosses in the midst of group (1) in the mica-belt of Bihār (**2**).

The rocks of group (3) are in general younger than those of the two preceding groups of crystalline rock, having attained their present position by eruptive transgression. As to groups (1) and (2), not only are we unable to determine their relative ages, but we are by no means certain that they are older than the Dhārwārs.

The Dhārwārian system.

The rocks of the Dhārwār system are generally quartzites and fissile schists, chloritic, talcose, micaceous, and hornblendic. The quartzites often include much iron ore, and all grades are found between a quartzite with a few crystals of magnetite or hematite, and beds of almost pure micaceous iron-ore. Among the chloritic and talcose schists there are at times beds of pot-stone, and even the finer grades of steatite, indicating, probably, the derivation of some of the material from the alteration of the ferromagnesian, peridotic rocks of igneous origin. Similarly, too, among the hornblendic schists relics of true diabasic structures are often preserved, and many of the beds are doubtless the result of the alteration of basic lava-flows, while others suggest ash-beds. In fact, all through these beds there is abundant evidence of igneous action, which is no more than one would expect to have been the case in the earlier days of the earth's history. Limestones are comparatively rare in the Dhārwār system, but they occur occasionally, and so, too, do true conglomerates which, notwithstanding the difficulty with which they are distinguished from autoclastic or crush conglomerates, may be taken as evidence of real water action in Dhārwār times (**5**).

The Dhārwārs have attracted a special interest on account of the valuable minerals they include: iron ores in great richness and purity in the Central Provinces and Bellary, copper ores disseminated at a particular horizon in Singbhūm, and gold in the quartz reefs of Kolār are examples well-known.

Upon the weathered surfaces of the highly folded Dhārwārs and the associated gneisses and schists of the Archaean group, enormous thicknesses of sediments were deposited in peninsular India. These rocks being devoid of fossils, isolated occurrences cannot with certainty be correlated, and consequently local names have been freely used to distinguish them. In Southern India we have the Cuddapah system, amounting to 20,000 feet in thickness with several unconformities, covered, also unconformably, by a thin series of strata distinguished as the Kurnools. Other examples of rocks of this class occur near Kalādgi in the Southern Marāthā country in the valley of the Bhīma, near Pakhal in the Godāvari valley, in the valley of the Pengangā, in parts of the Mahānadī valley, and in Chotā Nāgpur. Farther west, in Central India, are series of old rocks distinguished as the Gwalior and Bijāwar series, and finally there is the great Vindhyan system, all being unfossiliferous. The Purāna era. Distribution of the Purāna group.

A general survey of these old rocks reveals a lithological contrast between the lower beds, in which ferruginous jaspers and porcellanites are common, and the higher beds in which the rocks are shales, limestones, and sandstones, more nearly resembling materials formed by later common processes of sedimentation. The lower beds are also remarkable for the inclusion of basic lava-flows, which are conspicuous in the Gwalior series and in the Cheyār division of the Cuddapahs. The older division is thus represented by the typical Bijāwars, the Gwaliors, and the lower half of the Cuddapahs; while the younger division includes the original Vindhyans, the Bhīma series, the upper part of the Cuddapahs, and the Kurnools. Local difficulties must naturally occur in drawing a line between the older and the younger systems, and in the precise classification of isolated exposures of rocks belonging to the Purāna group; but such difficulties are the natural result of the conditions of sedimentation generally, deposition in one area, with a continuous record of beds, being contemporaneous with erosion and consequent unconformity in an adjoining district. Lower and upper divisions of the Purāna group.

In Southern India a great development of the Purāna strata has been preserved in the Cuddapah and Kurnool Districts, forming a basin of sedimentary rocks that cover some 14,000 square miles. The strata within this basin have been divided into two very unequal groups, on account of a marked unconformity between the lower 20,000 feet, distinguished as the Cuddapahs, and the upper 1,200 feet, known as the Kurnool series. The The Cuddapah and Kurnool systems.

Cuddapahs are divided into four series, separated from one another by unconformities; and it is highly probable that the lowest series in the Cuddapahs, in which we find the peculiar ferruginous jaspers and porcellanous beds, are the equivalents of the so-called Bijāwars and Gwaliors in Central India, while the upper series of the Cuddapahs and the associated Kurnools, in which normal sedimentary rocks occur, correspond generally with the Vindhyans.

The Vindhyan system.

The Vindhyan system is conspicuously displayed along the great escarpment of the Vindhyan range from which the rock system derives its name, stretching from Ganurgarh hill in Bhopāl territory east-north-eastwards to the ancient fort of Rohtāsgarh (24° 37′ N.; 83° 55′ E.). The rocks of this system are prominently sandstones, with subordinate bands of shale and limestone. Three of the massive sandstones, known as the Upper Bandair, Upper Rewah, and Upper Kaimur respectively, stand out conspicuously and determine the leading features of the main Vindhyan area. The system has been divided very unequally into a lower and an upper division; and the lower division includes large quantities of material that appears to have been ejected from volcanoes, producing beds of siliceous materials which, when very fine-grained, have a characteristically porcellanous aspect, and when in coarser fragments resemble some of the old European greywackes. The Vindhyan system, notwithstanding the apparent suitability of some of the shales and limestones for the preservation of fossil remains, has so far yielded no recognizable structures of organic origin, and its subdivisions are based on purely lithological characters (6). The system is remarkable for including rocks in which diamonds are found. These have been obtained in a band at the base of the Rewah stage in the State of Pannā, the horizon being apparently about the same as the Banganapalle beds in the Kurnool series of Southern India. The most important product of the system is, however, its resources in lime and building stone, which are referred to in the chapter on Mines and Minerals (Vol. III, chap. iii).

The Purāna group in Burma.

Unfossiliferous sedimentary rocks occur in Upper Burma below the Lower Silurian of the Northern Shan States. Their age is unknown; but they had been folded and greatly denuded before the Lower Silurian beds were deposited on their upturned edges, and their general strike of folding coincides with the schists which underlie them in the Ruby Mines District. The schists in their turn pass into gneisses with which are

found various forms of granulites and crystalline limestones; and this apparently gradual succession is similar to the order so frequently seen in the Himālayas, an association of beds among which it is almost impossible to make out a time-scale to distinguish upper from lower, or older from younger.

Possible existence of the Purāna group in the Himālayas.

The unfossiliferous rocks which occur so prominently in the outer hills south of the crystalline, snow-covered peaks of the Himālayas, illustrate the difficulty of distinguishing between upper and lower in a group of highly folded, often inverted, unfossiliferous rocks, and the impossibility of correlating one area with another, which combine to throw doubt on any systematic grouping of these strata.

Attempts have been made to distribute the various occurrences of these rocks over the recognized stratigraphical scale. Slates and quartzites in the Dhaola Dhār region have been referred to as Silurian, while associated volcanic rocks have been classed as Carboniferous, Permian, and Triassic. The well-known Blaini boulder-bed of the Simla area has been regarded as the equivalent of the Tālcher and Salt Range boulder-beds of Permian age, while the strata apparently above and apparently below have been relegated to higher horizons on the one hand and to the Carboniferous and lower on the other. The weak points in the arguments for and against these correlations are freely admitted by their authors, and they must be regarded, consequently, as mere attempts to draw the simplest natural inference from a few significant features in lithology and succession. There is one important feature, however, which has not received its full share of recognition: the fact that only unfossiliferous rocks occur south of the snowy range and crystalline axis, while fossiliferous beds varying from Cambrian to Tertiary extend along the whole length of the range on the Tibetan side, suggests an original difference between the two areas. Those on the south have a significant proximity to the peninsular unfossiliferous Purāna group, whose age is regarded as pre-Cambrian, mostly or wholly. That such old rocks extended far beyond their present peninsular limits is highly probable, and they may be represented in the enormous thicknesses of pre-Cambrian Vaikritas of the Central Himālayan and Tibetan zone of the range. Had the unfossiliferous rocks of the outer Himālayas been formed during Palaeozoic and Mesozoic times, it is hardly likely that they would have uniformly escaped the inclusion of fossils which are so abundant in the rocks of

corresponding age in the Salt Range, on the north-western frontier, in the Central Himālayas, and in Burma. It seems far more natural to suppose that a northern extension of the Purāna group has become involved in the Himālayan folding, while the beds of the Peninsula have remained undisturbed: the relations of the younger Gondwānas of the Darjeeling area to those of the Peninsula are precisely parallel to this. The suggestion is thus offered that the great masses of unfossiliferous rocks, well-known in hill stations like Simla and Nainī Tāl, the Attock slates farther west and the Buxa series farther east, should be referred to the Purāna group instead of being correlated with Palaeozoic systems.

III. Cambrian and Post-Cambrian History of India

A. THE DRAVIDIAN ERA

The Cambrian of the Salt Range.

The oldest fossiliferous strata we know in India are found in the Salt Range of the Punjab, where beds are exposed with fossils whose nearest relatives occur in the lower division of the Cambrian, the oldest fossiliferous system of Europe.

The undoubtedly Cambrian beds are found lying on a formation of peculiar marl with beds of rock-salt and gypsum, possibly of Tertiary age, similar to the salt deposits of the Kohāt area which will be referred to in describing the Tertiary system of India. The occurrence of such old beds, lying over masses of much younger material, is due possibly to the former having been thrust bodily over the salt-marl formation during the process of earth-folding.

The Cambrian strata of the Salt Range may be conveniently divided into the following series, which overlie one another in conformable sequence:—

4. Bhāganwalla, or Salt-pseudomorph series.
3. Jutāna, or Magnesian sandstone series.
2. Khussak, or *Neobolus* beds.
1. Khewra, or Purple sandstone series.

Purple sandstone and Neobolus beds.

The purple sandstones are quite devoid of recognizable fossils, but they frequently reveal the ripple-marks originally produced on the sandy shore on which they were formed. They graduate into the overlying dark-coloured shales and cream-coloured dolomitic rocks of the Neobolus series, which, by the fossils they contain, indicate the prevalence of a deep sea. The Neobolus series nowhere exceeds 150 feet in thick-

ness, but where best developed it is capable of subdivision into five zones, in the uppermost of which the principal fossils have been found. Besides the brachiopod genus *Neobolus*, which has given its name to the series, the most interesting form is a new genus of the peculiar Palaeozoic crustacean sub-class of trilobites recently distinguished by the name *Redlichia*. This form was until lately mistaken for the well-known *Olenellus*, a trilobite characteristic of the lowermost Cambrian (georgian) strata of Europe and America. The nearest relatives of *Redlichia*, as well as of the associated animal remains, occur, however, in the Lower Cambrian elsewhere, and the Neobolus beds may consequently be regarded as the homotaxial equivalents of these old rocks (**7**).

Magnesian sandstone series and salt pseudomorph zone.

The next series above is a sandy dolomite with intercalated argillaceous layers, and among the few and imperfect fossils they contain is one resembling the peculiar mollusc *Stenotheca*, Salter, found in the Lower Cambrian rocks of America. These beds gradually pass into the next higher, and uppermost, of the Cambrian strata preserved in the Salt Range, which are remarkable for the preservation of sandy models of cubic crystals, evidently pseudomorphs of salt crystals left by the evaporation of salt water before the deposition of succeeding layers of sediment. Here closes the first chapter in the geological history of the Salt Range; and between these rocks of Cambrian age and the next higher, which are not older than Upper Carboniferous, we have no record of sedimentation in this area, though the interval was wide enough for the deposition of three great systems of strata elsewhere, and for the evolution of several new classes of plants and animals.

Palaeozoic of the Central Himālayas.

For an imperfect record of Indian geological history during the great interval between the Cambrian and the Permo-Carboniferous rocks of the Salt Range we must turn to other areas, the best known being a zone of folded strata in the Central Himālayas, near the frontier of Tibet in the border tracts of Spiti and Kumaun.

The Vaikritas and Haimantas (Upper Cambrian).

The earlier records in this zone have been obliterated by metamorphism; but the great thicknesses of metamorphosed rock distinguished as the *Vaikrita* system pass gradually up into less altered strata, in the higher levels of which imperfect fossil remains have escaped destruction. These less-altered old strata are, on account of the snow-clad mountains which they form, named the *Haimanta* (snowy) system. The base of this system is fixed at an horizon of conglomerates which is

exposed only in the Kumaun end of the zone. The conglomerate series is overlaid by greenish phyllites, slates, quartzites, and grits with obscure fossils. In places these are altered by granitic intrusions. The uppermost division of the Haimantas consists of alternating beds of quartzite and shale, with narrow bands of dolomitic limestone, which become more important at the summit. The shaly beds include several trilobites of the family *Olenidae*, indicating an Upper Cambrian (Potsdamian) age. The dolomitic limestones are covered by red slates and reddish-brown dolomites, over which a conglomerate marks the unconformity separating the Cambrian from the succeeding Ordovician strata.

Gothlandian (Silurian). The Ordovician is represented in the Kumaun area by a coral limestone, while in Spiti this stage is probably not preserved, the lowest of the Silurian beds being red grits and quartzites, with overlying shales and limestones, which contain fossils, like the coral *Halysites catenularia*, Lmck., indicating an Upper Silurian (Gothlandian) age. The Gothlandian beds are overlaid by a grey limestone, which becomes reddish-brown on weathering, but has not yielded fossils sufficiently well-preserved to determine its exact age, though from its position it is probably Devonian. Then follows in conformable succession a formation which first develops into a red and then shades off into a white quartzite, named the Muth quartzite.

Conformable succession to the Carboniferous system. Over the Muth quartzite, where the complete sequence is displayed, as in the Lipak valley of Eastern Spiti, we find, in order, grey limestones with numerous brachiopods of Upper Carboniferous age; alternating beds of limestone, shale, and quartzite, with a thin band of conglomerate; and a thick covering mass of limestone with flaggy sandstones and shales, containing brachiopods and fragments of a trilobite belonging to the genus *Phillipsia*, Portl.; finally, shales distinguished as the *Fenestella* shales, with numerous specimens of this and other *Bryozoa* resembling some from the Zewān beds of Kashmīr, and thus probably of uppermost Carboniferous or Permo-Carboniferous age (8).

With these beds we approach the close of the second chapter in the geological history of Northern India; for at about this horizon, corresponding to the Upper Carboniferous of England, there is an important break in the deposition, and new conditions are introduced by a widespread conglomerate which forms the base of the division of marine sediments distinguished as the Aryan group.

The only other areas within British India where fossiliferous rocks of older Palaeozoic age have been found are in Chitrāl to the west and in Burma far away to the east. In Chitrāl Devonian fossils have been found in a limestone exposed on the right bank of the Chitrāl river, immediately opposite Reshun, where it seems to overlie a red sandstone and a still lower conglomerate. The best preserved of these fossils include corals and brachiopods, of which the corals show affinities with forms found in the Upper Silurian of England, while the brachiopods include forms like *Orthis striatula*, Schloth., *Spirifer extensus*, Sow., *S. disjunctus*, Sow., *Athyris concentrica*, v. Buch., and *Atrypa aspera*, Schloth., which have Devonian affinities, some of them resembling Devonian brachiopods found in Southern China (**9**). **Devonian of Chitrāl.**

A similar series of rocks, amounting to more than 2,000 feet in thickness in Hazāra, has, on account of its relations to the Triassic rocks in that area, been generally referred to as the infra-Trias. These beds are, however, almost certainly identical with the rocks just described in Chitrāl: the succession in both areas consists of a coarse conglomerate at the base, resting unconformably on a great slate series and overlaid by red or purple sandstones and shales, with limestone above as the principal member of the series. Fossils have not, however, been found in the Hazāra rocks. **Infra-Trias of Hazāra.**

Rock formations of Lower Palaeozoic age cover considerable areas in the Shan States and in Karenni. They are, however, so thoroughly covered with a coat of decomposition products, and often so concealed by the thick undergrowth of jungle, that precise information as to their structures and palaeontology is not easily acquired. But some calcareous shales and limestones have yielded *Echinosphaerites*, Wahl., one of the peculiar stalked cystoids so characteristic of the Ordovician system in Europe and America. In higher beds *Orthoceras*, trilobites, and graptolites have been found, and, with the last-named, a form of *Tentaculites* closely resembling the Ordovician form *T. elegans*, Barr. **Older Palaeozoic in Upper Burma.**

Devonian beds have also been recognized containing, with other fossils, the unmistakable and characteristic coral, *Calceola sandalina*, Lam. The predominating rock in this system is a limestone, distinguished as the Maymyo limestone, which extends, almost without interruption, from the neighbourhood of Maymyo to the Salween river in the Northern Shan States.

B. The Aryan Era

The Central Himālayan succession.

The changes in physical geography which occurred towards the end of the Carboniferous period are marked by a wide-spread conglomerate in Spiti and the Bhot Mahāls of Kumaun. This conglomerate forms the basement bed of a great series of strata which were laid down successively, without a sign of interruption or break, throughout a period corresponding to the whole of the Permian period and the succeeding Mesozoic era of Europe. The beds thus formed have been preserved in a zone lying to the north of the crystalline snowy peaks of the Central Himālayas near the boundary between Tibet and North-western India. Recent observations in Tibetan territory to the north of Sikkim show the eastward continuation of the younger fossiliferous strata of this series, which rest abruptly on the northern flanks of the crystalline axis, and probably cover the older beds which happen to be exposed in Spiti and Kumaun.

Trespass of a former central ocean.

The form of physical revolution which gave rise to this great series of strata appears to have been an eastern trespass of the Eurasian ocean, whose southern shore apparently coincided with the present line of snowy peaks, while an arm stretched into the Punjab as far as the Salt Range. Thus commenced what may conveniently be distinguished as the Aryan era in Indian geological history. The great central ocean above referred to, known to geologists as *Tethys*, flowed over a belt stretching across Central Asia, leaving deposits in which the fossil contents of places so widely separated as Burma, China, the Central Himālayas, Siberia, and Europe show the marked affinities due to free migration in the ocean.

The very complete scale of conformable strata preserved in the Central Himālayas attains a thickness of some 7,000 feet from the basement conglomerate below the Permian calcareous sandstone to the top of the Chikkim shales of Cretaceous age. The Permian 'Productus shales' pass up gradually into beds which introduce Triassic conditions through successive zones characterized by the genera of ammonites, *Otoceras*, *Ophiceras*, and *Meekoceras*. These are followed by beds with fossils so unmistakably characteristic of the Trias that the different stages recognized in Europe can be approximately defined and divided into zones. The Triassic rocks are followed by about 2,800 feet of Jurassic strata, among which occur the well-known Spiti shales, now known as far west as Hazāra and as far east as Sikkim. The Spiti shales are covered by the

Giumal sandstone and the unfossiliferous Chikkim series, which resembles the flysch deposits so frequently found in Cretaceous and Lower Tertiary formations (**9**).

Exotic blocks in the Central Himālayas.

One of the most interesting features in connexion with the geology of the Central Himālayas is the occurrence in the Kumaun section of numerous blocks of older rocks, mainly limestones, lying on the Spiti shales and the Giumal series without apparently any regularity of distribution. They are weathered into picturesque crags, rising in abrupt pinnacles with precipitous walls, and on account of their composition (often brightly-coloured, semi-crystalline limestones) they stand in striking contrast to the more sombre shales and sandstones forming the undulating country around. At first sight they recall the *Klippen* and *lambeaux de recouvrement*, or *blocs exotiques*, of the Alpine regions in Europe whose origin has been the subject of much controversy. In Europe these exotic blocks have been supposed to obtain their abnormal positions by being shorn off from highly crushed anticlinal folds, or by the removal of all but these fragments of enormous recumbent folds, or by faulting (**10**). Whether any or all of the theories employed to account for the Alpine exotic blocks are satisfactory appears to be far from settled; but the Himālayan examples seem to admit of a very simple explanation. They are always associated with igneous rocks, which are often amygdaloidal and otherwise generally agree in character with igneous rocks of surface (volcanic) origin. In these lava-flows the exotic blocks are buried by the hundred and are of various sizes. They are not only older than the Jurassic and Cretaceous strata they rest on, but belong to a facies either palaeontologically or lithologically foreign to the rocks of the same age in the Central Himālayas. They have thus come from a distance; and there being no signs of volcanic necks in the neighbourhood, the basic lava-flows in which they are embedded must have come from afar, like the flows characteristic of the so-called fissure eruptions, carrying with them their load of stratified rocks torn off from various horizons of the formations occurring in the area of eruption. It is assumed, for several reasons which need not be discussed here, that these exotic blocks belong to formations occurring farther north in Tibet, but political reasons have hitherto prevented the exploration of that country, and as a consequence this theory of the origin of the exotic blocks must remain for a time unverified: to establish it firmly it would be necessary to trace the blocks to their source, and to show that the fragments of basic lava in

which they are embedded are outliers of lava-flows farther north. As a first simple inference, however, from the facts so far available, the explanation just offered is, among the theories which have been considered, the one that offers least difficulty.

Carbo-Trias of the Punjab, the North-West Frontier Province, and Burma.

The Central Himālayan area is exceptional in possessing such a complete and unbroken succession of strata. As a general rule we find the Permian and Triassic rocks linked together, as in the Salt Range, on the North-western frontier, and in Kashmīr, while in other areas the Upper Jurassic and Cretaceous rocks are associated with one another. It will therefore be convenient to notice the other occurrences in approximately natural sub-groups, beginning with the Permo-Trias of the Salt Range, where we have the nearest approach to the remarkably complete succession of the Central Himālayas.

The Salt Range.

The first chapter in the geological history of the Salt Range closed, as already explained, in the Cambrian period, between which and the uppermost Carboniferous no traces of sedimentation have been preserved in that area (11). The second chapter opens with the remarkable boulder-bed which rests unconformably on the Cambrian strata. In its essential characters, as well as in its stratigraphical position, this boulder-bed corresponds to, and is probably contemporaneous with, the Tālcher boulder-bed at the base of the Gondwāna system in the Peninsula. On it, therefore, we have two great systems of strata developed: that in the Peninsula was formed in the river-valleys of the old Gondwāna continent, while the beds in the Salt Range, now to be described, represent the deposits which were laid down at about the same time in the adjoining ocean.

Permian boulder-bed.

The boulder-bed of the Salt Range, like that of the Tālcher series, has the peculiarity of being composed of a fine-grained silty matrix with included boulders of varying size up to several cubic feet. Many of these are faceted and striated in a manner which agrees with the general characters of the formation in pointing to a glacial origin; and several of them prove to be identical with the peculiar felsitic lavas we find in the Mallāni series, on the western flanks of the Arāvalli range, about 750 miles to the south. The glacial origin of the beds is shown also by the exposure of typically ice-scratched surfaces on the rocks they rest upon.

The fossils found in the beds immediately associated with the boulder-bed show a Carboniferous facies, having noticeable

affinities with forms occurring in the Upper Carboniferous marine beds of Australia, to which area the same great ocean apparently extended. Among the identical species in these two widely separated areas are *Eurydesma globosum*, *E. ellipticum*, *E. cordatum*, *Conularia laevigata*, *C. tenuistriata*, *Pleurotomaria nuda*, and *Martinopsis darwini*.

The beds overlying the boulder-bed introduce a change in the physical geography which commenced with the retreat of the Australian ocean, the development of an area of internal drainage unfavourable to life and to the preservation of organic remains resulting in the deposition of about 400 feet of red and purple sandstones and shales with gypseous bands. These beds are known as the *Speckled Sandstone* series. Speckled sandstone series.

Further developments in the local physical geography resulted in the gradual encroachment of a western ocean which opened up marine communication with the European area, and gave rise to the formation of a system of fossiliferous rocks, mainly limestones, which, on account of the abundance of a genus of brachiopods, is known as the *Productus Limestone*. The lower beds are sandy and coaly in the east, but become more calcareous towards the west, that is, as we pass out to the deeper sea; and as we ascend in the series we find the encroachment of the sea more completely established, with the production of purer limestones. This lowest division of the Productus limestones is distinguished as the Amb series; and some of its fossils show great affinities with those of the Gshelian stage of Russia and the Fusulina limestones of the Carnian Alps, strata which are regarded as Upper Carboniferous in age. Many of the species are found also in the Artinskian (Permo-Carboniferous) and in even younger stages in Europe; but the fact that most of the fossils belong to the class of brachiopods, whose species, on account of their stationary habits, have a wide vertical range, prevents the more precise correlation which would have been possible if the animals had belonged to migratory forms like the cephalopods, which we shall find to predominate in the Triassic beds overlying the Productus limestones. Among the brachiopods characteristic of the Amb beds, or Lower Productus series, are *Productus lineatus*, Waag., *P. cora*, d'Orb., *P. spiralis*, Waag., *P. semireticulatus*, Schl., *Athyris roysii*, Leo., *Spirifer marcouii*, Waag., *S. alatus*, Schl., *Martinia glabra*, Mart., *Reticularia lineata*, Mart., *Orthis pecosii*, Marcou, and *Richtofenia sinensis*, Waag., the last-named being one of the peculiar aberrant forms of brachiopods which also characterize beds of this age in Southern China, an area to

Productus limestone series.

Lower Productus limestones.

which this great Eurasian ocean extended in Permo-Carboniferous and Permian times.

Middle Productus limestones. The middle division of the Productus limestones forms a large and conspicuous fraction of the whole formation, being characterized by the prevalence in it of more exclusively Permian fossils. Its younger age is also marked by the appearance of forms, like the lamellibranch *Oxytoma*, Meek, not known elsewhere below the Trias, and of *Nautilus peregrinus*, which has a near relative in the Jurassic strata of Europe. There are three well-marked palaeontological zones in this middle division. The lowest of these is characterized by the survival of the foraminiferal genus *Fusulina*, Fisch., which, with its relative *Schwagerina*, Möll., attained an enormous development in Carboniferous and Permian limestones elsewhere. The central zone is distinguished by including the peculiar brachiopod *Lyttonia nobilis*, Waag. The occurrence of the cephalopod *Xenodiscus* (*Xenaspis*) *carbonarius* in the uppermost zone of this division of the Productus limestone formation indicates a greater affinity of the series with the Triassic beds than would be supposed from the fossils mentioned above, and it is possible that a re-examination of this interesting series of beds will place it on a level with the Zechstein of Europe.

Upper Productus limestones. The upper division of the Productus limestones shows still more the approach of the conditions characteristic of Mesozoic times by the appearance of several forms of true ammonites with complicated sutures. Prominent among these species are *Cyclolobus Oldhami*, Waag., *Medlicottia Wynnei*, Waag., and *Euphemus indicus*, Waag., which predominate in successive zones from below upwards in this order.

Gradual passage from Permian to Triassic. As in the Central Himālayas, so in the Salt Range, there is a perfectly gradual passage from strata which are unquestionably Permian up to beds which contain an essentially Triassic fauna. To draw a line, therefore, exactly corresponding to the base of the Trias in Europe is as difficult as it is unimportant: the main point to establish is the fact that the perfectly conformable passage is accompanied by the gradual replacement of typical Palaeozoic forms by characteristic Mesozoic fossils. Within a few feet of the beds containing the highest remains of the genus *Bellerophon*, we meet with limestone containing traces of ammonites; and from this horizon up for over 200 feet, in a typical section near the village of Chideru (32° 33′ N.; 71° 50′ E.) in the western part of the Salt Range, we find beds in which the character-

istic Triassic ammonite *Ceratites*, Haan, occurs so abundantly that its name has been employed to distinguish the whole series (**12**).

According to the predominating rock, this series can be divided into four lithological stages and five palaeontological zones, as follows:—

5. Upper Ceratite limestones .	Zone of *Stephanites superbus*.
4. Ceratite sandstones . .	Zone of *Flemingites flemingianus*.
3. } Ceratite marls . . .	Zone of *Koninckites volutus*.
2. }	,, ,, *Prionolobus rotundatus*.
1. Lower Ceratite limestones .	Zone of *Celtites sp*.

Of these, zones 1 and 2 are characterized by the frequent occurrence of the genus *Meekoceras*, Hyatt, and zones 3, 4, and 5 by the abundance of fossils belonging to the genus *Hedenstroemia*, Waag. Palaeontologically, therefore, the beds are capable of division into two stages which correspond approximately to the beds in the Trias of the Central Himālayas, where *Meekoceras* is found associated with *Ophiceras* and *Otoceras* in a series of limestones and shales, which are in turn covered by further beds in which *Ceratites* is well represented with, as in the Salt Range, *Flemingites flemingianus*, Waag. With the Ceratite beds, which are approximately equivalent to the Lower Trias of Europe, the second chapter of the Salt Range closes; and all younger records, representing the Muschelkalk, the Upper Trias, and the two lower divisions of the Jurassic system, have, if they ever existed, been completely removed.

The Ceratite formations.

Exposures of beds belonging to different parts of the Permo-Trias so well displayed in the Salt Range occur at different points farther north. In the Bannu District, for instance, a boulder-bed with scratched and faceted boulders, like the well-known occurrence of the Salt Range, occurs covered with limestone containing fossils of Pẹrmian age. In this area the Triassic Ceratite limestones also follow in conformable succession, while the Trias is likewise represented in Hazāra. Permian limestones with fossils like those of the Productus limestone series have been found in Chūra and the Bāzār valley, but the Palaeozoic rocks are apparently covered up by younger formations south of the Safed Koh (**13**).

Permo-Trias on the North-western frontier.

The Permo-Triassic series of Kashmīr have a special interest, on account of the occurrence of remains of the Lower Gondwāna plant *Gangamopteris* associated with those of typical Permo-Carboniferous fishes and labyrinthodonts (**16**).

Jurassic, to the neocomian, without any decided unconformity. These rocks have been divided into four series distinguished by local names as follows:—

Umia	Portlandian to Neocomian.
Katrol	U. Oxfordian and Kimmeridgian.
Chāri	Callovian and L. Oxfordian.
Patcham . . .	Bathonian.

Jurassic of Jaisalmer.

The great mantle of sand which has spread over Rājputāna during recent times effectually conceals large areas of rocks, patches of which here and there peep through; but, being isolated, they cannot be grouped with certainty except where they are fossiliferous. In the neighbourhood of Jaisalmer, however, there are highly fossiliferous limestones which include many forms identical with those characteristic of the Chāri series of Cutch, and these are overlaid by other series consisting of sandstones and limestones which have yielded fossils resembling those of the Cutch Katrol series. We thus have proof that the sea extended so far eastwards during Upper Jurassic times.

Jurassic of the Salt Range.

From Jaisalmer to the Salt Range, where we find marine Jurassic rocks again, is about 350 miles due north, the whole country between being completely covered with recent alluvial accumulations. In the Salt Range, we have, as already described, an uninterrupted succession from the Permo-Carboniferous to Lower Triassic times; then an interruption occurs, and the next formation preserved is of Middle or Upper Jurassic age. These strata are developed in the western part of the Salt Range extending to the Indus, being exposed again farther west to the Chichāli (Maidāni) hills (32° 51′ N.; 71° 11′ E.) and in the Sheikh Budīn hills (32° 18′ N.; 70° 49′ E.). Small patches of coal occur near the base of the series; and for the rest it consists of an alternation of conglomeratic sandstones, shales, and limestones, the last-named being especially developed in the western exposures. Two less usual formations are a bed of hematite and layers of a peculiar golden oolite, similar to that well-known in Cutch. So far as they have been examined, the fossils correspond with those of the Chāri and probably also of the higher series of Cutch.

Relics of the great cenomanian transgression.

The narrow encroachments of the sea which took place in Jurassic times on the Peninsula were extended during the Cretaceous period, and especially in cenomanian times, when pro-

found changes occurred in the physical geography of the earth. Relics of this Cretaceous transgression of the ocean, preserved on the Coromandel coast of Madras and in the Narbadā valley, are well-known examples which may be conveniently selected for special notice.

Coromandel Cretaceous.

The best studied of these marine formations is that represented by three patches on the Coromandel coast, where, by a very narrow accident of relative level between sea and land, we find highly fossiliferous rocks which have made a contribution of inestimable value to our knowledge of marine zoology in Upper Cretaceous times. Situated as a sort of half-way stage between the Pacific and the Atlantic areas, this coast, which was immersed to a very small depth, formed a home and final resting-place for many animals which migrated under stress of competition from one region to the other, marking out their route, like the old East Indiamen, by wrecks on the southern coast of India, in Natal, and on the west coast of Africa. The fossil remains include many forms which appear to have flourished from Brazil right around the oceanic belt to British Columbia, together with others which modified themselves to develop species peculiar to the conditions in various parts of the Cretaceous sea. Supposing a few feet of elevation in Cretaceous times, and no shells would have stranded on the shelving beaches of the Coromandel coast; a similar amount of depression in recent times would have hidden the deposits beyond the reach of the geologist. As it is, the small patches of strata on the eastern coast of Madras form a little museum of Cretaceous zoology, in which nearly a thousand species of extinct animals have been recognized; and, by the inclusion of many cosmopolitan forms, they permit the correlation of these rocks with those in many parts of Europe; Syria; the north-western borders of India; North, West, and South Africa, and Madagascar; Brazil; the Eastern, Central, and Western States of the American Union; British Columbia; Japan; Sakhalin; Borneo; and Australia (1).

The Trichinopoly area.

The highly fossiliferous Cretaceous rocks of the Coromandel coast form three small patches separated from one another by the alluvium of the Vellār and Penner rivers, and by the subrecent Cuddalore sandstones. The largest of the three patches is in Trichinopoly District; the other two are west of Cuddalore and north-west of Pondicherry respectively. They rest on the eroded surface of the old gneiss, or unconformably on the Upper Gondwāna beds.

The fossils show a range in age from the lowest beds corre-

sponding with the upper greensand (cenomanian) to the danian. The strata are divided as follows into four stages:—

NINNIYŪR STAGE .	Large specimens of *Nerinea*, *Nautilus*, &c., with many Foraminifera, especially *Orbiloides*, filling the hard matrix of large shells. *Nautilus danicus*, Schloth.	Danian.
ARIYALŪR STAGE .	*Trigonoarca galdrina*, d'Orb., very abundant. Other common forms are *Nerita divaricata*, d'Orb., *Rostellaria palliata*, Forb., *Exogyra*, and *Alectryonia*.	Upper Senonian.
TRICHINOPOLY STAGE	(*b*) Zone of *Placenticeras tamulicum*, Blanf.	Lower Senonian.
	(*a*) Zone of *Pachydiscus* aff. *peramplus*, Mant.	Turonian.
UTATŪR STAGE . .	(*c*) Zone of *Mammites conciliatus*, Stol. (*b*) Zone of *Acanthoceras mantelli*, Sow. (*a*) Zone of *Schloenbachia inflata*, Sow.	Cenomanian.

The Utatūr stage.

The lowest of these stages, distinguished by the name Utatūr, is only partially covered by the younger beds, and is exposed as a wide band along the western border of the Trichinopoly Cretaceous patch. Its base is generally a coral-reef limestone; but the principal part of the series consists of fine silts, calcareous shales, sandy clays, sands, grits, and some conglomerates. The fossils include fragments of cycadaceous woods, often bored by molluscs, with a rich assemblage of marine forms generally indicating, by their nature and mode of preservation, a littoral habit. Near the base of the Utatūr stage occurs the common lower cenomanian ammonite *Schloenbachia inflata*, Sow., a species characteristic of this horizon in Europe, West Africa, Brazil, Australia, California and elsewhere; but more especially of the Cretaceous rocks of the Atlantic province. The majority of the fossils are, however, near relatives of, or identical with, those found in the Pacific province. In the higher beds there is a rich *Acanthoceras* fauna, including the world-wide form *A. rhotomagense*, Brong., found also at various places in Europe, Syria, the Caucasus,

Persia, and the regions bordering the north-west of India, Japan, South, West, and North Africa, and Madagascar: in this zone, also, *Turrilites costatus*, Brong., and *Alectryonia carinata*, Lam., agree in indicating a middle and upper cenomanian age.

The uppermost zones of the Utatūr stage mark the commencement of turonian conditions by the appearance of the characteristic lamellibranch *Inoceramus labiatus*, Schloth., and of ammonites related to the European form *Mammites nodosoides*.

There is a slight break between the Utatūr and the next overlying Trichinopoly stage, shown by a stratigraphical unconformity, as well as by a considerable change in the fauna. Among the Trichinopoly beds there occur typical relatives of *Pachydiscus peramplus*, Mant., an ammonite characteristic of the lower chalk of England, and of the corresponding horizon in many other parts of the world, ranging over the Atlantic province, and in the Pacific area as far as Japan. The higher Trichinopoly beds mark the incoming of a lower senonian fauna among the gastropods and lamellibranchs as well as among the ammonites. Thus the genus *Schloenbachia*, Neum., represented in the lowest Utatūr beds by *S. inflata*, Sow., is here represented by the *tricarinata* type.

The Trichinopoly stage.

Then follows the Ariyalūr stage, covering a large area on the east side of the Trichinopoly patch. A point of peculiar interest in connexion with this series is the occurrence in it of a tooth and some ill-preserved bones of the dinosaurian *Megalosaurus*, resembling *M. Bucklandi*, a well-known form from the Stonesfield slate, belonging to the bathonian stage or great oolite of England, and thus much older than these rocks in Southern India. As this genus is not known above the neocomian in Europe, we have another example of the class, so well illustrated by the Gondwāna fossils, showing the different rates of development which occur in widely separated land areas, cut off by sea or by other physical barriers from one another. The most important cephalopods in the Ariyalūr beds are the upper senonian species of *Pachydiscus* and *Baculites*, *B. vagina*, Forb., being especially characteristic. Apparently this series is also represented in the Pondicherry area, where, as in Trichinopoly, the next and highest stage is also preserved.

The Ariyalūr stage.

The Ninniyūr beds are intimately related to those of the Ariyalūr stage, but contain a fauna sufficiently characteristic to permit their correlation with the danian stage of the Upper

The Ninniyūr beds.

Cretaceous in Europe. Thus the disappearance of ammonites and other characteristic Mesozoic forms foreshadows the faunal characters which distinguish the approaching Tertiary period. The characteristic form, *Nautilus danicus*, Schloth., makes its appearance, and the only other genus that requires mention to ensure the Mesozoic character of the beds is the gastropod *Nerinea*, Defr., whose name is used to distinguish the highest beds in the Pondicherry area. Thus closes the most complete fragment of Mesozoic history in peninsular India, the only record we have of the life in the seas washing the Coromandel coast when the Mesozoic era was approaching its close in Europe. The Cretaceous sea, which left such perfect samples of its inhabitants on the Coromandel coast, also stretched north-eastwards as far as Assam; and there, on the margin of a mass of old rocks which formed a part of the peninsular crystalline gneisses, it deposited limestones, sandstones, and shale beds, containing numbers of fossils identical with the more completely studied formations in Southern India.

Bāgh beds. The rocks of corresponding Cretaceous age on the western coast are known as the Bāgh beds, which occur in the Narbadā valley and separate the Deccan trap-flows from the underlying Archaean gneisses. Some forty species of marine animals have been identified in these beds, including a few cosmopolitan forms which show a specific identity with those in the Coromandel beds, but many of them are distinct types manifesting a greater affinity with Cretaceous fossils from Arabia, Palestine, and Europe, areas which were covered by the same great ocean. In Kāthiāwār some sandstones in the neighbourhood of Wadhwān resemble the Bāgh beds in lithology, in the few imperfectly preserved fossils which they have yielded, and in their position unconformably below the Deccan trap-flows.

The Gondwāna system. Above the youngest member of the Vindhyan system there is a great gap of unknown width in the geological history of peninsular India; and it is probable that much of the record has been destroyed by denudation, for its next chapter commences with a formation deposited on a land surface when India was part of a large continent exposed to the weather.

The oldest rocks after the Vindhyans are distinguished as the Tālcher series, which form the lowermost stage in a great system of sub-aerial and fresh-water deposits known as the Gondwāna system. In Gondwāna times India, Africa, Australia, and possibly South America, had a closer connexion than they appear to have at present. Although probably at no time forming a continuous stretch of dry land, they were suffi-

ciently connected to permit of the free commingling of plants and land animals. At different parts of this great southern continent there occur peculiar boulder-beds whose special characters appear to be best explained as the result of ice action. The boulders of this peculiar formation of the Tālcher series vary from mere pebbles to blocks weighing many tons, generally well rounded and rarely scratched, lying often in a matrix of fine silt, a matrix which would not exist if the boulders had reached their present positions by rolling in rapid streams. The formation in New South Wales which is taken to be the equivalent of the Tālcher boulder-bed has a similar structure, with large and sometimes striated boulders embedded in a fine, silty matrix; and in this case the tranquil conditions under which the formation was laid down are shown by the inclusion of numerous delicate *Fenestellae* and undisturbed bivalves lying in the silt. The age of the Australian formation is fixed by the associated Upper Carboniferous marine beds, and this testimony agrees with that of the boulder-bed of the Salt Range already referred to (*ante*, page 70). In Kashmīr, beds have been found containing *Gangamopteris* (a typical Lower Gondwāna plant), associated with fish and labyrinthodont remains related to those of the Permo-Carboniferous in Europe (**16**).

Boulder-beds in Gondwāna land.

The lowermost beds of the Gondwāna system are thus fixed by indirect evidence as Upper Carboniferous or Permo-Carboniferous in age. Later on it will be shown that the uppermost stages of this system are associated with marine deposits of oolitic, or possibly neocomian, age. We thus have a great system of strata ranging from the Carboniferous, through Permian and Triassic times, to the period during which the well-known oolites of Europe were formed. The fossil contents of this system give a record of the natural history of the great southern continent of Gondwāna, which differs in a remarkable and most interesting way from that of the northern hemisphere. Allusion has already been made to this in the Introduction; and after a brief description of the subdivisions of the Gondwāna formations, the question will be referred to in greater detail, though the few pages to which this chapter is necessarily limited are insufficient for a full discussion of a subject which possesses such an important bearing on palaeontology. The reader who wishes for more information is referred to the memoirs cited at the end of the chapter.

Age of the Gondwāna system.

The Gondwāna rocks are preserved as small patches let down, mostly by faulting, into the great crystalline mass of

Distribution of the Gondwānas.

the Peninsula. Originally they must have covered a much wider area; but as the Peninsula has been exposed ever since to the free action of weathering agents, the Gondwāna formations have been cut into like the older formations, and the coal-measures thus preserved in India now form but a fraction of those that once existed. Isolated patches of Gondwāna rocks, including coal beds, have been involved in the folded extra-peninsular area, in the Darjeeling District, and in Northern Assam. The string of Gondwāna patches which determines the direction of the river Dāmuda includes our most valuable deposits of coal. Their faulted, parallel boundaries and general east-west alignment suggest the action of the same earth movements as occurred in structural lines parallel to the subterranean ridge of high specific gravity running across India to the south of this line—the great depression of the Gangetic valley and, farther afield, the main axis of folding in the Himālayan region. All these phenomena are probably connected, though not necessarily contemporaneous.

The Tālcher series.

The lowest subdivision has already been referred to as the Tālcher series. The rocks of this series are generally soft sandstones and peculiar silty shales, often of a greenish hue, which break up in a most characteristic way into small angular fragments. The peculiar characters of the Tālcher rocks permit their ready recognition; and though a comparatively thin formation, probably not exceeding 800 feet in thickness, they are developed, with all their peculiar characteristics, over an enormous area on the Peninsula.

In the upper layers only a few plant remains have been found; but the Tālchers generally, notwithstanding their lithological suitability for the preservation of delicate fossils, are remarkably devoid of signs of life, a feature which is consistent with the evidences of great cold indicated by the glacial boulder-beds near the base of the series.

Dāmuda series.

The next younger beds are grouped together under the name Dāmuda series, and these are subdivided in Bengal into the following stages :—

3. Rānīganj stage.
2. Ironstone shale stage.
1. Barākar stage.

Barākar stage.

The Barākars are recognizable in many other areas; but the upper stages cannot be identified with certainty, and local names like Kamptee, Bijori, and Motur are used to distinguish the Dāmuda beds above the Barākars in other coalfields. It is in the Dāmuda series that the most valuable Indian coal-seams

occur. The associated rocks are all sandstones and shales, which sometimes attain a thickness of 10,000 feet. The ironstone shale stage is so called on account of the lenses of clay-ironstone which, as in the Rānīganj coalfield, sometimes occur in sufficient abundance to supply a valuable iron-ore. All these stages are in general conformity with one another, though the upper may be found to overlap the lower.

Pānchet series.

There is generally, however, a slight unconformity between the uppermost stage of the Dāmuda series and the next, which is distinguished as the Pānchet series. The Pānchets are characterized by the absence of coal-seams, being composed of micaceous sandstones, often of a greenish colour, with bands of red clay. The series is well-known on account of the reptilian and amphibian fossil bones it has yielded, besides a few fossil plants which show more pronounced affinities with those of the Dāmudas than with the higher beds.

The whole of the foregoing series—Tālcher, Dāmuda, and Pānchet—make up the lower division of the Gondwāna system, being cut off from the Upper Gondwānas by a marked stratigraphical break, accompanied by a contrast in fossil contents. The plants of the Lower Gondwāna beds include many equisetaceous forms, while those of the Upper Gondwānas show a prevalence of cycads and conifers; the species of common genera of ferns, as well as other orders, are quite distinct in the two divisions.

Upper Gondwānas.

The Upper Gondwānas have a lower series, distinguished as the Rājmahāl series in Bengal and as the Mahādevas in the central parts of the Peninsula. The Mahādevas attain a thickness of 10,000 feet in the Sātpurā area, most of the rocks being sandstones and unfossiliferous. The Rājmahāls, on the other hand, have yielded a number of fossil plants, and are interesting, too, on account of the great sheets of basaltic lava interstratified with the shaly and sandy sediments, attaining a thickness of over 2,000 feet. The Rājmahāl lava-flows are often amygdaloidal like those of the Deccan trap series, the cavities yielding agates and zeolites of considerable variety and beauty.

Rājmahāl and Mahādeva series.

Marine beds of Upper Gondwāna age.

Rocks of Upper Gondwāna age occur at various places along the east coast of the Peninsula. In some cases marine fossils have been found associated with the plant-bearing beds, and these have helped to fix the position of the Upper Gondwānas in the standard scale of marine strata. More pronounced evidence as to the age of the upper limit of the Gondwānas is afforded by the occurrence of plant-bearing

beds in the so-called Umia series of Cutch, whose age has been already referred to as about equivalent to the neocomian of Europe (*ante*, page 76).

The Kota-Māleri series.

A series between the Rājmahāl horizon and the Umia series deserves special mention on account of the animal remains which it has yielded. Its beds occur in the Godāvari valley, and have been named the Kota-Māleri series from two villages near which they are developed. In the lower or Māleri stage fossil remains of the remarkable fish *Ceratodus*, species of which are still living in Australian waters, and of the reptilian genera *Hyperodapedon* and *Parasuchus*, have been found with numerous coprolites; while in the Kota stage a greater variety has been found, including the crustacean *Estheria*, and several forms of fish and reptiles, with plant remains which indicate the position of these beds in the Gondwāna sequence.

Characters of the Gondwāna fossil plants.

At the time when the *Glossopteris* flora flourished on the great southern continent of Gondwāna-land, *Lepidodendron*, *Sigillaria*, and *Calamites* were conspicuous among the forests of the northern hemisphere. But the separation of the two great continents was not sufficiently complete to prevent the southward extension of some members of the *Lepidodendron* flora to Africa and South America; and the fact that typical members of the Upper Palaeozoic *Lepidodendron* flora, as it is known in Europe and North America, have now been found associated with the *Glossopteris* flora in South America and in South Africa proves beyond question that the two were co-existent (**25**).

The Glossopteris flora of Gondwāna-land.

The predominant flora of the Lower Gondwāna system, in which *Glossopteris* and *Gangamopteris* are prominent genera, has much closer affinities with the Mesozoic plants of Europe than with the plants of the Upper Palaeozoic coal-measures. This fact at first seemed inconsistent with many other evidences pointing to an Upper Palaeozoic age for the Lower Gondwānas; but the explanation offered by the earlier members of the Geological Survey of India, though for many years a stumbling-block to European palaeontologists, has received conclusive support in recent times. A flora closely resembling that of the Indian Gondwānas was found represented also in Australia, South and East Africa, Argentina, and Brazil. In most of these places, too, the formations in which the fossil plants occurred were associated with a boulder-bed having the peculiarities of that at the base of the Indian Gondwānas, and regarded as the result of ice action by the Indian geologists. With a boulder-bed of Permo-Carboniferous age at the

base, and a marine intercalation of Jurassic and neocomian forms near the summit of the Gondwāna system, we have an inferior and a superior limit of the time-scale over which to distribute its various series. A considerable fraction of the lowest beds must represent the Permo-Carboniferous, Permian, and Triassic periods; and yet the plants they contain show, when compared with European fossils, a predominating Rhaetic and Jurassic facies. The remarkable agreement between the *Glossopteris* (Gondwāna) flora of India and the fossil plants of similar formations in Australia, Africa, and South America can only be explained on the assumption that these lands, now separated by the ocean, once constituted a great southern continent.

Existence of an old Indo-African continent. That India and the southern and central parts of Africa were once united into one great stretch of nearly continuous dry land is proved by overwhelming evidence (**17**). In the first place, besides the remarkable correspondence among the plants which flourished during Upper Palaeozoic times in India, South Africa, and the portions of East Africa which have been explored, there is an agreement between the peculiar generalized labyrinthodonts and reptiles of which remains are found in the Pānchet series of India and in corresponding beds in South Africa. So far as this evidence goes, it points either to a complete land connexion, or to an approximation sufficiently close to permit free migration of land animals and plants.

Evidence from Jurassic fossils. A study of the distribution of Jurassic cephalopods indicates the existence of a tropical sea to the north-west of this supposed land barrier, and of a cold sea to the south-east. The separation was not, however, sufficiently complete to prevent the migration of species from the Cutch area, which we presume to have been on the north-west side of the barrier, to the Lower Godāvari, which was probably on its south-eastern shores. But a shallow strait in Upper Jurassic or Lower Cretaceous times would be sufficient to account for the small amount of commingling thus indicated by the occurrence of identical species on opposite sides of India.

Evidence from the Cretaceous deposits. The Upper Cretaceous fossils demonstrate the existence of the land barrier more completely. The marine Cretaceous beds near Bāgh, in the lower Narbadā valley, contain fossils which, especially the echinoderms, show striking resemblances to those of the Cretaceous beds of Syria, North Africa, and Southern France, all patches of rocks deposited in the great ocean of which the modern Mediterranean is a shrunken relic.

But the Bāgh beds differ in facies from the Cretaceous beds of the Trichinopoly area, since in the latter, though there are many forms that had a world-wide distribution in Cretaceous times, types related to the fossils of the Pacific province preponderate, as shown by numerous correspondences with South Africa, Borneo, Japan, Sakhalin, Chili, California, Vancouver, and even as far as Queen Charlotte Islands. We have thus a contrast between the Mediterranean-Atlantic Cretaceous province and that of the Pacific, and this contrast is preserved in the Bāgh beds on the west of India and the Trichinopoly formations on the east coast. The evidence goes even farther, for in Assam, Trichinopoly, and South Africa the Cretaceous beds show a distinctly littoral character, indicating the fact that the old Mesozoic coast-line on the east was not far from a line joining these places.

Persistence of the old continental ridge.

There is still another piece of evidence as to the existence of the old Indo-African continent, all the more striking because it belongs to an entirely different field of observation. It is found that between the Seychelles, which are connected by comparatively shallow waters with Madagascar and Africa, and the Maldives, which are on the Indian continental platform, there exists a submarine bank, preventing the ice-cold Antarctic currents that characterize the greater depths in the South Indian Ocean from extending into the Arabian Sea, which has thus a higher temperature than the water at corresponding depths to the south of this bank. We have here the remains of the old continent, depressed sufficiently to cut off India from South Africa, but still enduring as a bank between the great abyssal depressions to the north-west and the south-east.

Effects of the old continent on the modern distribution of animals.

Finally, the modern distribution of animals is explained by this occurrence of a Mesozoic Indo-African continent, and in turn furnishes further evidence in favour of the conclusion already based on palaeontological data. Within the part of India south of the Gangetic plain are numbers of genera and species not found in other parts of the Indo-Malayan region, which have near relatives in Madagascar and South Central Africa. These, distinguished as the Dravidian constituent of the Indian fauna, are comparatively low forms, mostly reptiles, batrachians, and invertebrates, with only one mammalian genus, *Platacanthomys*. The likeness between the Dravidian fauna of the Indian Peninsula and some forms in Madagascar can only be accounted for by this supposition of an ancient land communication, while the amount of divergence they

show is no more than would be expected from independent evolution, since the separation occurred in early Tertiary times (**18**).

The break-up of Gondwāna-land.

The great revolutions in physical geography, which took place towards the end of the Cretaceous and during early Tertiary times, resulted in the break-up of the old Gondwāna continent, and were followed by the rise of the Himālayan range. These orogenic movements appear to have been caused, or accompanied, by igneous action on an unusually grand scale. The great masses of basic lava covering more than 200,000 square miles in peninsular India remain as a fragment of the enormous flows which must have spread over that area, and probably over a very much larger portion of the old Gondwāna continent to the west and south, now buried under the Indian Ocean or removed by denudation. Among similar phenomena in other parts of the world, at or near the same period, may be mentioned the great basaltic flows of North-western Europe with their associated granites, gabbros, and other intrusive rocks, and the Laramie series in the United States which very closely parallels the case of the Deccan trap of India. Besides the Deccan trap, other intrusive and extrusive igneous rocks made their appearance at about the same time in parts of extra-peninsular India. Burma contains intrusives of basic and ultra-basic rocks cutting through the early Tertiary strata, and now remaining as conspicuous masses of serpentine. In the North-western Himālayas similar rocks, accompanied by volcanic ashes and probably also by lavas, were formed during and subsequent to lower eocene times, while in Baluchistān even more extensive series of eruptions have been detected. Finally, with this great period of earth-movement we must connect much of the granite which is so prominent in the Central Himālayas and contributes to the great core of the range.

Igneous outbursts at the end of Mesozoic times.

The Deccan trap.

The most extensive and best known of the instances of eruptive activity which characterized the close of the Mesozoic, and the opening of the Cainozoic, era is naturally the Deccan trap. The great lava-flows which make by far the chief part of this formation constitute the plateau of the Deccan, concealing all older rocks over an area of 200,000 square miles, filling up the old river valleys, and levelling the surface of the country. Subsequent denudation has carved these lava-flows into terraces and flat-topped hills, with, as in the seaward face of the Sahyādri or Western Ghāt range, steep scarps, rising to about 4,000 feet and indicating a part only of the original thickness of the accumulated lavas, ashes, and beds

of interstratified marl. The trap-rock is usually a form of olivine basalt or augite-andesite, rarely porphyritic, but often vesicular with amygdala of beautiful zeolites, calcite, and agate.

The Lameta series.

At the base of the flows are beds in which limestones of lacustrine origin predominate. These beds, known as the Lameta series, were laid down unconformably on all the older formations, even on the youngest members of the Gondwāna system, while they were themselves exposed to local denudation before the lavas spread over and protected them from the weather.

Among the few fossils which have been found in the Lameta series are the bones of a large dinosaur, *Titanosaurus indicus*, Lyd., allied to some Lower Cretaceous and Upper Jurassic reptiles in Europe. The occurrence of this form in strata which are certainly not older than Upper Cretaceous agrees with the evidence of the *Megalosaurus* from the Ariyalūr stage of Southern India, in pointing to the backward state of evolution among Indian reptiles in Upper Mesozoic times—one more among the many evidences from Indian geology to prove that correlation of strata by land animals often contradicts the evidence of marine forms.

Age of the Deccan trap.

In making an attempt to fix the position of the Deccan trap in the European stratigraphical scale, the chief point to guide our judgement is the fact that we are limited below by the cenomanian (Bāgh) beds and above by the Nummulitic rocks of Cutch, while in Baluchistān what appears to correspond to the base of the series is associated with marine strata of about senonian age, and in Sind the upper flows have spread out over beds regarded as equivalent to the oldest Tertiary in Europe. The eruptions thus probably began at about the time of the formation of the upper chalk of England, and finished before the remarkable foraminiferal genus *Nummulites* made its appearance and spread throughout the great Eurasian central ocean. During this interval, which geologically is a very short one, there was time for the accumulation of lava-flows which amounted to not less than 6,000 feet in thickness in some places, with intervals of rest sufficient for lakes, stocked with fresh-water mollusca, to form on the cold surfaces of several of the lava-flows. So this remarkable accumulation of volcanic materials has remained until to-day, with its original horizontality of bedding but slightly disturbed. Except on its north-western fringe, where it was bent down with the subsiding land to the north to suffer the encroachment of the early Tertiary sea, it has remained exposed to the weather, which has carved

the great lava-flows to produce the characteristic scenery of the Deccan plateau.

Until the Deccan trap has been dissected out by the weather in the way in which the Tertiary basalts of North-western Europe have been cut up, we shall have very little visible evidence of the masses of ultra-basic rocks which almost certainly lie below. But it is just possible that portions of these ultra-basic rocks have been squirted into the early Tertiary rocks of the North-western frontier; and the numerous masses of olivine-rock exposed in Mysore and the Madras Presidency may even have had a similar origin, though it is also conceivable that the latter are as old as the Cuddapah lava-flows which, like the Deccan trap, once extended far beyond their present limits. These dunite-masses in Madras can be dismissed with a very few words. The majority of them are almost pure olivine, though at times they contain enstatite and chromite, and locally pass, by concentration of other minerals, into various forms of picrite. But the chief feature of interest in connexion with these rocks is their frequent, almost constant, decomposition into magnesite without ordinary serpentinous alteration. The original olivine-rocks must have been attacked by water and carbonic acid of deep-seated origin, probably originally contained in the magma; and, with the formation of magnesite, chaladonic silica is also separated. The so-called Chalk Hills near Salem (11° 39′ N.; 78° 10′ E.) form a well-known instance of these peridotite eruptions, being so named because of the abundance of dazzling white magnesite.

Ultra-basic relatives of the Deccan trap.

Dunites of South India.

Passing on to Burma, we find numerous and large masses of peridotite which were erupted in early Tertiary times. Unlike those of Madras, whose age, it should be remembered, is unknown, the Burma peridotites are always much serpentinized. One instance, interesting because of its connexion with the valuable mineral jadeite, may be taken as an example. In Upper Burma, in the vicinity of Tawmaw (25° 44′ N.; 96° 14′ E.), serpentinous rocks are found piercing strata of miocene age. Microscopic examination of the rock shows that large quantities of the original olivine have escaped hydration, but most of the mineral has been altered to serpentine. The jadeite occurs in the masses of serpentine, standing out, when exposed, by its white colour against the dark-green serpentine (**91**).

Serpentines and jadeites in Burma.

Serpentinous masses, presumably of the same age as that intrusive in the miocene rocks of Upper Burma, are found also

as irregular bosses and dikes at various places mainly on the eastern side of the Arakan Yoma, where they are intruded into rocks of the Chin series. The serpentine, with chromite, found in the Andaman Islands probably belongs to the same series of eruptions.

Igneous action in Baluchistān.

Baluchistān was the scene of the grandest and most interesting manifestations of igneous action during this period. With the beds of volcanic ash which are found below the hippuritic limestone (Cretaceous), and at different stages to the middle eocene, there are certain basic intrusions which, with the ash beds, were formed before the folding of the rocks, and have consequently suffered the usual deformations. Either as a cause or as an accompaniment of the folding movements, great intrusions of granophyric rock—granites and more basic types—were forced into the Nummulitic limestone and associated rocks some time after the close of the eocene period. Then followed the injection of dikes and sills of dolerite before the pliocene strata were deposited. But this did not close the volcanic action in this interesting area: lavas and ashes were ejected and further material injected into the pliocene (Siwālik) rocks, while eruptive activity persisted on to recent times in Baluchistān as well as in Persia, and some of the volcanoes are still active, though showing signs of senility (**20**).

Tertiary gabbros and granophyres.

With a brief remark on the granitic rocks, because of their possible connexion with the Himālayan granite, we must leave this attractive section of Indian geology. It is interesting to note that the granites found cutting the limestones, which are full of Nummulites, often show the peculiar granophyric structure so characteristic of the similar early Tertiary rocks of North-western Europe, that they pass in the same way into more basic types also with micrographic structures, and that they are similarly traversed by basaltic dikes. But besides these peculiar features they are in places porphyritic, and otherwise recall some granites in the Central Himālayan zone.

The Tertiary period. The passage from Cretaceous to Tertiary.

While the Deccan trap was being poured out on the Peninsula of India, at the time when the typical Cretaceous fauna of Europe was gradually giving way to the forms which mark the distinctly Tertiary formations, deposition was going on in the seas washing the west coast of India; and as a result we have preserved, in parts of Sind and Baluchistān, sediments which contain fossils with affinities both to the Cretaceous and to the Tertiary types. The exact side of the dividing line on

which a particular formation should be placed can be decided only by detailed examination of its fossil contents.

In one of these cases, which alone there is space to mention, we have a series of beds in which some highly fossiliferous olive-coloured shales contain large quantities of a peculiar globose species of lamellibranch, *Cardita beaumonti*, which gives its name to the formation. Associated with this form are reptilian remains with Mesozoic affinities, besides corals and echinoids of mixed Cretaceous and Tertiary types which have yet to be critically examined. The association, as an interbedded flow, of amygdaloidal trap with the *Cardita beaumonti* beds gives one fixed point for the age of a portion of the Deccan trap. **Cardita beaumonti beds.**

The Tertiary system which forms the southern fringe of the Himālayas is divided as follows:—

Siwālik series . .	Upper Siwālik.	
	Middle Siwālik.	
	Lower Siwālik or Nāhan stage.	
Sirmūr series . .	Kasauli stage	Murree beds.
	Dagshai stage	
	Sabāthu stage.	

A review of these Tertiary deposits shows a general passage from marine beds at the base to the great river deposits of the Siwāliks, which are essentially similar in origin to the modern alluvia deposited by the rivers emerging from the Himālayan valleys on to the plains of Hindustān. **Himālayan Tertiaries.**

The lowest or Sabāthu stage of the Sirmūr series consists of a highly disturbed set of grey and red gypseous shales, with layers of limestone and sandstone, in which the fossils indicate a marine origin and an age equivalent to the Nummulitic beds. **Sabāthu stage.**

The Dagshai stage, with its hard, grey sandstones and bright-red clays, follows conformably above the Sabāthu beds, and in turn passes up into the Kasauli stage, which is essentially a sandstone formation in which the clay beds are distinctly subordinate in quantity. **Dagshai stage.**

On reaching the Kasauli stage all evidences of marine action disappear, and the deposits seem to have been formed in fresh water, the sea having then permanently retreated from the plains of Northern Hindustān, while the conditions favourable to the formation of the great thicknesses of sandstones, clays, and conglomerates which mark the Upper Tertiary, or Siwālik, series were developed. **Kasauli stage.**

Wide extent of Nummulitic stage.

Marine conditions prevailed in Lower Tertiary (Nummulitic) times along the foot of the Himālayas, as far east at any rate as Garhwāl, and the deposits of marine Sabāthu beds can be traced at intervals north-westward to Jammu, while Nummulitic rocks occur also in the Salt Range; over various parts of the North-West Frontier Province, covering up large tracts of older rocks; at the back of the zone of crystalline, and now generally snow-covered, peaks in the far parts of Kashmīr and Ladākh; on the Tibetan border in Spiti and Kumaun; and away to the far east in the region of Tibet north of Sikkim. Still farther east, in Assam and Burma, Nummulitic rocks occur in numerous places. Within the limits of this chapter it is possible to refer to a few only of the remarkable features of this widespread series of deposits. The guiding line throughout is generally the occurrence of the remarkable foraminifer *Nummulites*, which, on account of the way it spread itself throughout Europe and Central Asia in early Tertiary times, is as useful in marking a stratigraphical horizon as the freely migrating cephalopods of the Mesozoic group.

Sind Tertiaries.

In Sind, where the Tertiary marine rocks have attained an exceptional development, the following subdivisions are recognized:—

Manchhar	Miocene to Pliocene.
Gāj	Miocene.
Nāri	Oligocene.
	Priabonian.
Kīrthar	Lutetian.
	Ypresian.
Rānīkot	Sparnacian.
Cardita beaumonti beds . .	Montian.

The lower portion of the Rānīkot stage is poor in fossils, consisting of pyritous and carbonaceous shales and soft variegated sandstones with gypsum. The upper beds, however, are rich in marine fossils, among which in the two uppermost zones are Nummulites of different species which persist thence, through the Kīrthar, to the Lower Nāri stage.

Tertiaries in Baluchistān.

The great thickness of beds represented by the Rānīkot and Lower Kīrthars has not been preserved in Baluchistān, where a series of beds distinguished by the name Ghāzij rest directly, and with distinct unconformity, on the *Cardita beaumonti* beds. The Ghāzij passes locally into flysch-like material (the Khojak shales), which apparently accumulated with rapidity and produced a great thickening of the beds

without much change in their fossil contents. Above the Ghāzij-Khojak stage we find a limestone formation, known as the Spīntangi stage, which is represented in parts of Baluchistān, and caps the scarp of the Kīrthar range between Baluchistān and Sind. The great thickness of Khojak, Ghāzij, and Spīntangi beds in Baluchistān represents merely the Upper Kīrthar of Sind. Between the middle eocene Spīntangi beds of Baluchistān and the Lower Nāri (upper eocene) there is a distinct unconformity, corresponding approximately to the bartonian of England. But this gap is not apparent in Sind, the yellow or brown Nāri limestone following the white limestones of the Kīrthar stage with seeming conformity. With the Lower Nāri end the Nummulites, and the limestones in which they occur are succeeded by a great thickness of comparatively barren sandstones.

Representatives of the Nummulitic series, which are so well developed in Sind and Baluchistān, occur also in Cutch and Kāthiāwār, in Surat and Broach.

Rock-salt in the Lower Tertiaries.

The Lower Tertiary rocks of the Kohāt region are remarkable for the valuable deposits of rock-salt which occur at their base, and which, in default of contradictory evidence, are assumed to be of Tertiary age, though the base of the salt-bearing series is not exposed. The salt, and its associated gypsum, shales, and sands, in the Kohāt region present certain characteristics which distinguish the formation from the salt-marl occurring so mysteriously below the Cambrian beds of the Salt Range in the Punjab. The colours are generally grey instead of reddish, and the potash and magnesium minerals of the Salt Range are not found in the Kohāt area.

Lower Tertiaries in Kashmīr, Ladākh, and Assam.

The Lower Tertiary rocks of the Kashmīr and Ladākh area deserve special mention on account of the associated peridotites and basic igneous lavas and ashes—a set of rocks which, placed in this stratigraphical position, suggests a genetic connexion with the great Deccan trap eruptions and some of the basic eruptives of Baluchistān of about the same period.

The Nummulitic rocks of Assam are of importance on account of the economic value of their limestones, coal-beds, and mineral oil, which are referred to in detail in the chapter on Mines and Minerals (Vol. III).

Miocene of Sind and Burma.

In miocene times the sea was driven back, and marine strata of this age are consequently restricted to areas nearer the present coast lines. In Sind there is a fine display of marine miocene beds in the Kīrthar range, where the series is cut through by the Gāj river and is named the Gāj series in

consequence. In Cutch beds of corresponding age are well developed, while far away on the other side of the peninsular mass there are relics of the miocene sea in Upper Burma, distinguished as the Yenangyaung series.

Tertiary records in Burma.

The earliest records of the Tertiary history of Burma are still sealed up in a great thickness of flysch-like shales and limestones which, occurring in the forest-clad and almost inaccessible Arakan hills, have only been superficially examined. Above these, on both flanks of the zone of older rocks which stretches from Cape Negrais northwards to Manipur, we find marine beds, the Bassein series, of upper eocene age, showing that a great part of this area was covered by a shallow sea. This sea became, in lower miocene times, silted up by sand and mud, with included organic remains, which afterwards gave rise to the thin coal-beds and petroleum-bearing sands of the Prome stage. Then followed a further inroad of the miocene sea, with its corals, echinoderms, molluscs, crustacea, and fish, many of whose direct descendants are living to-day in the Indian and Pacific Oceans. These, and the deposits formed in the estuaries of the rivers which poured their contents into the miocene sea of Burma, constitute the Yenangyaung stage. Then followed the changes which, after a local denudation of the Yenangyaungian sediments, resulted in the deposition of 20,000 feet of sandstones in river valleys that formed the home in pliocene times of many remarkable mammals and reptiles, contemporaneous with, and in many cases similar to, the animals whose remains have made the Siwālik series so famous. The folding of these pliocene rocks, distinguished as the Irrawaddy system, into a north and south series of anticlines and synclines introduced the modern physical conditions of Burma, and determined the disposition of the great valleys of the Irrawaddy, Sittang, and Salween, whose sediments are in places burying, while in others the rivers are cutting away, the deposits produced by the great rivers which drained this area in pliocene times. The southerly extension of the Irrawaddy series is buried under the delta of the river, and possibly even under the Andaman Sea, where a longitudinal depression forms the submarine continuation of the Irrawaddy basin, and comes to the surface in the Andaman and Nicobar Islands, where, besides unfossiliferous rocks similar to those of the Chin series of the Arakan hills, there are younger soft limestones, clays, and coral sands whose precise age is not known.

Table of Tertiary Formations in Burma.

Formations.	Origin.	Age.
IRRAWADDY SYSTEM.—20,000 feet. *Upper series.*—Yellow, friable sandstones with beds of brown clay. No fossil bones, fossil wood scarce. *Lower series.*—Yellow, friable sandstones and conglomerates. Much fossil wood and bones.	Terrestrial and Fluviatile.	Pliocene.
PEGU SYSTEM. *Yenangyaung series.*—2,400 feet. Glauconitic sandstone and olive-green clays. *Prome series.*—3,100 feet. Petroliferous sandstones, blue clays, and coal-seams.	Estuarine and Marine.	Miocene.
BASSEIN SYSTEM.—1,200 feet. Sandstones and shales capped by Nummulitic limestones.	Marine . .	Eocene.
CHIN SYSTEM.—Over 10,000 feet of unfossiliferous shales and limestones.	. . . .	Undetermined.

The Chin series has not, so far, yielded any fossils, and beyond *Nummulites* very little has been obtained from the Bassein series; but one of its fossils, *Velates Schmiedeliana*, Chemn., is a gastropod of great interest on account of this further evidence of its wide distribution and consequent value as a means for determining the geological horizon. From France, this gastropod ranges through Italy, Egypt, Persia, Cutch, Sind, and Western Burma, being a widely distributed inhabitant of the great Mediterranean sea which stretched as a belt across this area in early Tertiary times. Chin series.

But the chief interest to the student of natural history lies in the rich molluscan fauna of the Yenangyaung series of the miocene Pegu system. These beds, well exposed in the anticline near Yenangyat (21° 6′ N.; 94° 51′ E.) and southwards to Minbu (20° 10′ N.; 94° 53′ E.), have yielded 167 species of *Pelecypoda* and *Gastropoda*, of which 30 per cent. are either identical with or closely related to species now living in the Indian Ocean, and 19 per cent. have near relations still living in the Western Pacific. While no species among this assemblage of molluscs is identical with any found in the Yenangyaung series.

miocene beds of Europe, 14 per cent. have their nearest relatives in the well-known eocene beds near Paris. These facts indicate an easterly migration of many of the molluscan animals during Tertiary times, the descendants of the eocene sea of Europe living in the miocene sea in India and Burma, and contributing, by further movement eastward, to the fauna now living in the seas of Japan, China, the Philippines, and Australia. The miocene beds of Burma have thus yielded forms which constitute connecting links between living forms in the Pacific and closely related extinct species which lived in the eocene sea of Europe. In some of these cases the living species are, so far, only known east of Singapore, having apparently, during the continuation of this easterly migration after miocene times, become extinct as far as the Indian Ocean is concerned, while their descendants have passed on to the Pacific (**21**).

The Siwālik series. The name Siwālik, now applied to the fringing foothills of the Himālayas in the United Provinces and the Punjab, is also used to indicate a great system of river deposits remarkable for its wealth of vertebrate fossil remains. The deposits of sands, clays, and conglomerates are essentially similar to those formed in modern times by the Himālayan rivers; and their relations to the modern alluvium show that they were produced in the same way, and were then caught up in the folding movements by which the Himālayas, rolling out as a mighty rock-wave towards the south, rose as the greatest mountain range in the world.

The most interesting and, for stratigraphical purposes, the most important among the fossil remains found in the Siwāliks are those of vertebrate animals, especially of the mammalian class. The exact horizon of many of the specimens was not recorded by the collectors; and it is consequently not certain whether the apparent mixture of forms having relatives in the oligocene, miocene, and pliocene strata of Europe correctly represents the life in the jungles of the Himālayan foothills, or whether the order of succession was the same as in Europe. The general facies of the fauna, however, shows predominating pliocene affinities, on the whole newer than the fossils of the Manchhar beds in Sind, for which an upper miocene age is accepted on stratigraphical as well as palaeontological evidence.

A remarkable feature in connexion with the Siwālik vertebrate fauna is the abundance of the larger mammals, and the predominance of true ruminants over the artiodactyle ungulates. Out of sixty-four genera of mammals which have been identified

among the Siwālik fossils, thirty-nine have species still living, while twenty-five are now extinct. Among the reptiles only two out of twelve genera are extinct, while all the birds and fishes whose remains have been examined belong to living genera. The impoverishment in variety of large mammals since pliocene times is a feature of considerable interest, as it is not peculiar to India and is supposed to be due to the effects of the glacial epoch. We have now but a single species of elephant in India to compare with the eleven species which lived at the foot of the Himālayas in pliocene (Siwālik) times, while the two species of *Bos* now living in India are all that are left of the six which formerly lived in the Siwāliks.

The Irrawaddy system. Very pertinent evidence as to the age of the Upper Siwāliks is obtained in Burma, where the basin of the Irrawaddy contains a great system of beds, chiefly composed of yellow sands, which attain in some places a thickness of 20,000 feet and rest, with slight unconformity, on marine beds whose miocene age is placed beyond doubt by their fossil contents. **Fossil wood.** Two features of special interest in connexion with these beds may be mentioned: one is the common occurrence at various horizons of pieces of silicified, exogenous wood; the other is the abundance in the two lower zones of vertebrate remains agreeing very closely in character with many of the remarkable forms which have made the Siwāliks so famous.

The vertebrate fossils are, from the geological point of view, the more interesting. The specimens so far collected appear to belong to twenty-six species, of which only thirteen have been specifically determined, and eleven of these are identical with forms known in the Upper Siwāliks. The undetermined species belong to genera which are all known in the Siwāliks; so there is a sufficiently complete correspondence to justify us in regarding the Irrawaddy system as the equivalent of the Upper Siwāliks. As the stratigraphical position of the Irrawaddy system shows it to be of pliocene age, we thus have a confirmation of the conclusion which has been arrived at by a comparison of the Siwālik fauna with the pliocene fossils of other lands.

Tipam sandstones of Assam. It is probable that the rocks known as the Tipam sandstones in North-eastern Assam are of the same age as the Siwāliks and the Irrawaddy series, but no unquestionable fossils have been found in them.

Post-Tertiary development. Since pliocene times, when the Himālayas finally rose as a great barrier between India and the rest of Asia, considerable changes have taken place in the physical geology of the

Recent volcanic action.

country. In the two great areas of folding which meet the eastern and western extremities of the Himālayan range volcanic action has persisted down to recent times. On the east we have Barren Island, Narcondam, and Puppa, representing the northern extension of the line which in the region of Sumatra, Java, and the Sunda Islands has been so remarkable for its volcanic activity, while on the west, in the Irānian region of folding, we have volcanoes like Koh-i-Sultān, Koh-i-Tafdān, and Basman Koh now settling down to the solfataric stage.

Earthquakes.

Earthquakes tend generally to be more frequent in the regions of extra-peninsular India, where the rocks have been recently folded, than in the more stable Peninsula; and the areas which have recently come into prominence in this connexion are the Province of Assam and the Kāngra valley in the Punjab Himālayas. In the former tract the most violent earthquake on record occurred on June 12, 1897. The known extent of the area over which the shock was distinctly felt was about 1,200,000 square miles. Within the epifocal area of 10,000 square miles, which was situated in Western Assam and Eastern Bengal, alterations have occurred in the heights and relative positions of the hills, in addition to the usual phenomena of earth-fissures, sand-eruptions, small faults, and the destruction of buildings. The violence of the movements is shown by the fracture of upright stones, indicating, in the case of short stones which were broken and overturned, a modified form of projection, while in others there was distinct rotation by the action of a vorticose motion in the ground. In the alluvial areas the effects were especially conspicuous, vibrations being noticed in the distant and detached alluvial area of Ahmadābād, though the earthquake was not noticed over the rocky ground to the east for about a hundred miles. In the Assam-Bengal alluvial area the river channels were narrowed, railway lines were bent into sharp curves and bridges compressed, while fissures and sand-vents opened in myriads. Ever since the great earthquake of 1897 the same area has been disturbed by small shocks, more than 5,000 being recorded during the following year (**22**).

The Kāngra earthquake occurred on April 4, 1905, at an early hour in the morning, in consequence of which it resulted in a great loss of human life, estimated at about 20,000. Its epifocal area lay about a curved NW.–SE. line, some 160 miles long, extending from the neighbourhood of Kāngra, through Kulū, to near Mussoorie. This line corresponds to a fault or chain of faults, which, emerging near the surface in

the Kāngra valley, caused the greatest destruction near the north-west end of the line, with an intensity of shock diminishing to the south-east, where the focus was deeper below the surface. The area of extensive damage to masonry buildings was only about 5,800 square miles, as compared with 150,000 square miles of similar damage in the Assam earthquake of 1897. But on account of the great depth of the focus at its south-easterly end, the waves spread out over a wide area, and serious damage was caused over about 27,000 square miles, while the shock was sensibly felt over an area nearly as large as that disturbed in 1897, being recognized as an earthquake as far west as Quetta, as far south as Surat in Bombay and False Point in Bengal, and as far east as Lakhimpur in Assam.

Recent rises and subsidences of the land. Within India proper there have been local changes in the relative level of land and sea within recent geological times, in some cases connected with earthquakes, as in the case of the earthquake of Cutch in 1819 when a part of the Rann was submerged, and in the Assam hills, among which alterations of level and horizontal distance were detected by measurements after the great earthquake of 1897. The Andamans and Nicobars have been isolated from the Arakan coast by submergence at a probably recent date.

On the east side of Bombay Island trees have been found imbedded in mud about 12 feet below low-water mark, while a similarly submerged forest has been described on the Tinnevelly coast. On the other hand, there is evidence to show that a part of the coast of Tinnevelly has risen and driven back the sea in the neighbourhood of Kāyal. Again, the accumulations of thick masses of old alluvium in the rocky basins of the Narbadā and Tāpti rivers indicate changes in the relative levels of the upper or eastward, and lower or westward, parts of these basins.

Pleistocene alluvium in the Narbadā and Godāvari valleys. The clays and sandstones of uppermost pliocene or of pleistocene age which are found in the Narbadā valley have sometimes been referred to as the older alluvium of the Narbadā—a misleading expression, as, although they were formed under fresh-water conditions, they could not have been deposited in their present position in a rock basin by the Narbadā river as it now exists. They include remains of mammalia specifically, and sometimes generically, distinct from forms now living, and among them bones of a hippopotamus now represented only in Africa. The molluscs in these deposits belong to known living species of fresh-water habit; and the rocks therefore cannot be older, probably, than

pleistocene, though some of the mammals are identical in species with those in the pliocene Siwālik series.

Recently, among the older alluvium of the higher part of the Godāvari valley, in the Nāsik District of Bombay, remains of extinct vertebrates have been found, including a skull of *Elephas namadicus*, Falc. and Caut., of exceptional size. Remains of *Hippopotamus* and *Bos namadicus* have recently been obtained in wells 80 feet below the bed of the Ganges near Allahābād. These, like the vertebrate remains found many years ago in the Jumna valley, indicate a pleistocene age.

Porbandar stone. One of the most interesting among sub-recent and recent formations is the calcareous freestone, largely used for building purposes in the Bombay Presidency, which is quarried from deposits that occur near Porbandar and other places on the Kāthiāwār coast. The rock consists largely of the remains of minute foraminifera, with small quantities of sand grains which have been transported by the wind from the sea-shore. Deposits of this nature attain thicknesses of 200 feet, showing their characteristic false-bedding, near Junāgarh, which is 30 miles from the coast; but the foraminifera are carried much farther inland, being found as far as Bīkaner in the Rājputāna desert. The rounded and small shells of the foraminifera which make up such a large part of the Porbandar stone are often mistaken for oolitic grains, which also occur in the deposit (**23**).

The Indo-Gangetic alluvium. The most important and extensive among the deposits of very young age in India are the great alluvial accumulations on the confluent plains of the Indus, Ganges, and Brahmaputra. Throughout the great Indo-Gangetic alluvial area a sandy micaceous and calcareous clay forms the prevailing material, the older alluvium being distinguished by the nodular segregations of carbonate of lime, called *kankar*, used largely as a source of lime and as road metal. These alluvial deposits have been penetrated by borings in two places below the sea level. The boring at Calcutta reached a depth of 481 feet without signs of either a rocky bottom or marine beds, while fragments of fresh-water shells were found as low as 380 feet below the surface, and coarse pebble beds were met throughout the lowest section of the borehole, showing that the present site of Calcutta was near the margin of the river valley which has undergone depression accompanying the accumulation of alluvial material. The boring at Lucknow extended to nearly 1,000 feet below sea-level, with no further sign of an approach to the bottom than that shown by the appearance of coarse sand near the end of the hole.

Upland river deposits.

Besides the deposits formed by the great rivers on the plains of India, Assam, and Burma, there are interesting river deposits at higher levels, like those of the upper Sutlej valley in Hundes, which have yielded numerous vertebrate fossil remains; the *karewa* deposits of the upper Jhelum in Kashmīr; the so-called *tanr* lands of Nepāl, in which beds of peat and phosphatic clay occur; and the similar deposits in Manipur and farther east in the Chindwin valley of Burma.

Wind-blown deposits.

The sand-dunes of the coast of Orissa, the *teris* of Tinnevelly and Travancore on the coast, the accumulations of blown sand on the banks of the Kistna, Godāvari, and Cauvery, the great gravel slopes which form the *dāman* fringes of the Baluchistān hills, the finer loess of the plains, the extensive accumulations of the Potwar, the great desert sand deposit of Rājputāna and Sind, and the peculiar black soil or *regar* so widely distributed over the Deccan must be passed by with a mere mention.

Laterite.

The rust-coloured caps which frequently cover the rocks in moist tropical climates, and have been known for a century under the name *laterite*, have long been a puzzle to geologists. In its typical form this material has a vesicular or scoriaceous appearance, on which account it has been supposed by some to have a volcanic origin. Occasionally it has a pisolitic structure, and is often mottled through irregular distribution of the ferric hydrate stain. There is hardly a doubt about the fact that most, and probably all, real laterites are formed by the subaerial decomposition of the rocks on which they lie, and that the peculiar structures they show are the result of molecular segregation among these products. For a long time laterite was regarded as merely a ferruginous clay, formed by the decomposition of the aluminous and ferromagnesian silicates in the rocks which are attacked by the weather; but analyses recently made show that much of the silica has been removed during the process of rock decomposition, and that the alumina, instead of being retained as a hydrous silicate such as we get in a clay, is often present as a simple hydrate of alumina, being stained red with the corresponding hydrates of iron, and mechanically mixed with other substances set free during the processes of rock-weathering. Analyses show a great variation in composition; but there is a general tendency among laterites to differ from the rocks from which they are derived by the concentration of alumina, iron oxide, and titania, while the silica, alkalies, and alkaline earths are carried away by the atmospheric waters. The fact that this peculiar form of rock-weathering is characteristic of, and practically confined to,

moist tropical climates has given rise to the suggestion that the alteration of the fresh rock is effected by the action of some organism, which grows at the surface of the rock and possesses the power of breaking up the rock silicates. The separated silica is removed in solution, while the hydrated alumina and iron oxide remain behind, and, by their segregative power, cement the other products into a mass with the peculiar structures which characterize laterite (**24**).

Laterite may become broken off and carried to lower levels by the action of streams, and when re-deposited at lower levels may become cemented again into a compact mass by the segregative action of the hydrates, including sand-grains of quartz and other minerals. Thus there are *high-level* laterites, resting on the rocks at whose expense they have been formed, and *low-level* laterites, formed in the usual way of detrital deposits.

Laterites of past ages.

Laterites are not merely modern formations; several old land surfaces show traces of lateritic deposits. On the old surface of India, for instance, which was overwhelmed and covered by the Deccan trap in uppermost Cretaceous times, laterites existed, and are sometimes now exposed where the weathering agents have cut away the protecting layer of trap. At the base of the Tertiary rocks north-east of Surat, and at a few other places, are rocks having such a perfect resemblance to modern laterite that there is little or no doubt that the conditions for the formation of this peculiar material existed in early eocene times, and it is probable that many of the bauxites of Europe and America have a similar origin.

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CHAPTER III

METEOROLOGY

I. General Meteorology of India

THE area dealt with in the present chapter includes the whole of India proper, with Burma and Baluchistān. It is not a self-contained area, as its meteorology depends very largely upon the oceanic area to the south and also, to a slighter extent, upon the regions to the north and north-west, more especially Central Asia and the Persian area or plateau. The object of this chapter is not only to give a statement of the larger seasonal weather changes, but also to indicate, so far as at present possible, their relation to each other, and their co-ordination to meteorological conditions and actions in the neighbouring areas of land and sea.

Meteorology of India of singular interest.

India probably presents a greater variety of meteorological conditions, actions, and features than any area of similar size in the world. The normal annual rainfall varies from 460 inches at Cherrapunji in the Assam hills, and from between 300 and 400 inches (probably) at suitably exposed positions on the crests of the Western Ghāts and the Arakan and Tenasserim hills, to less than three inches in Upper Sind. The largest rainfall actually measured in India in one year was 905 inches, at Cherrapunji in 1861, while at stations in Upper Sind it has been *nil*. A rainfall exceeding 25 inches within twenty-four hours is of occasional occurrence, and falls exceeding 15 inches are comparatively frequent. At one period of the year parts of India are deluged with rain; at another persistent dry weather with clear skies prevails for weeks or months. During the rains the air is almost supersaturated with moisture in some of the coast districts and in the hills, while in the hottest weather it is occasionally so dry in the interior that the methods employed for calculating humidity in Europe have given negative and hence impossible results. The coasts are occasionally visited by cyclones fiercer and more concentrated than have probably ever occurred in Europe. These bring up storm-waves that sweep over the low coast lands of Lower

First, on account of its variety and contrasts.

Bengal or the deltas of the Mahānadī, Godāvari and Kistna, destroying the crops, and drowning the inhabitants by tens of thousands. In one season of the year India is the scene of the most wonderful and rapid growth of vegetation; in another period the same tract becomes a dreary brown sunburnt waste, with dust-laden skies and a heated atmosphere that is almost unendurable even by the natives of the country. The transition from the latter to the former phase over the greater part of the interior often occurs in a few days. In one year the rains may be so distributed as to cause a severe and extensive famine over several Provinces, necessitating for months afterwards the continuous relief of millions of the population; in another the meteorological conditions may be so favourable that the crops far more than suffice for the normal food demand.

Secondly, as combining tropical and temperate region conditions. India again presents a noteworthy combination of tropical and temperate region conditions. Tropical heat, heavy and frequent rain, and fierce cyclones are prevalent at one period of the year; while moderate temperature and rain, with shallow extensive storms—conditions resembling those of South-eastern Europe—obtain at another.

Thirdly, as an area of pronounced monsoon conditions. In the third place India is *par excellence* the area in which the contrast of what are termed monsoon phases or conditions is exhibited most strongly over a large area. These conditions are the prevalence of dry land winds, with little cloud and rain, during one half of the year, and of winds of oceanic origin, with high humidity, much cloud and frequent rain, during the other half.

Initiation and development of meteorological observation and inquiry in India. The work of meteorological observation was begun by the East India Company at the end of the eighteenth century. Observatories of the first rank were established at Madras in 1796, at Simla in 1840, at Bombay in 1841, and on the Dodabetta Peak (Nīlgiris) in 1847. The observatories at Simla and Dodabetta were closed after a few years' work, but those of Bombay and Madras have been continued until the present time and have furnished most valuable series of observations. Observations (chiefly of temperature and rainfall) were also taken at many hospitals, but in many cases these were carelessly recorded and are of little scientific value. The progress of meteorological inquiry in England, and its utilization for the purposes of storm warning after the Crimean War, suggested the commencement of systematic meteorological observation in India. Isolated and independent Meteorological Departments were started by four of the Provincial Governments—in Bengal in 1865, in the United Provinces in

1864, in the Punjab in 1865, and in the Central Provinces in 1868. The Bengal Meteorological Department was initiated chiefly for the purpose of conveying warnings to the port of Calcutta; the other three for supplying information to the local medical authorities, in the hope that it might enable them to trace out the relations between weather and disease. These local departments were of some service in collecting meteorological data, but they were found to be of little use for the investigation of the larger phases and changes of weather in India. The Government of India accordingly decided to imperialize the system, and sanctioned the necessary arrangements for the extension of the work of observation to the whole of India, for the adoption of uniform methods of observation, and for the systematic discussion of the observations as a whole. The Imperial Department thus formed was placed under the control of a scientific officer with full powers to carry out the sanctioned reforms. This change was effected in 1874-5, and the present system has thus been in operation for thirty years. At the end of 1902 the following observatories were in existence:—

Present constitution of the Meteorological Department.

A magnetic and meteorological observatory at Colāba, Bombay (of the first rank).

A solar physics, magnetic, and meteorological observatory at Kodaikānal, on the Palni hills in Southern India (of the first rank).

An astronomical and meteorological observatory at Madras (of the first rank).

A central meteorological observatory (of the first rank) at Calcutta (Alipore), where all instruments are tested before issue and their corrections to the India standards determined.

231 meteorological observatories (of the second and third rank) maintained by the Government of India or by Native States working in co-operation with the Government. Twenty-three of these are mountain observatories situated at elevations exceeding 5,000 feet, the highest being those at Leh in Kashmīr (elevation 11,503 feet), at Kyelang (10,087), and the Chaur Peak (11,200) in the Punjab.

2,390 rain-gauge stations, recording and reporting rainfall only.

The gazetted staff of the Department includes—in addition to its head, who is Director-General of Indian observatories—the Directors of the Kodaikānal and Colāba observatories and

the First Assistant Meteorological Reporter to the Government of India (all of whom are whole-time officers); the Provincial Meteorological Reporters at Allahābād, Bombay, Calcutta, and Madras, of whom the three latter issue Provincial Daily Weather Reports; and an Assistant Meteorological Reporter in charge of the Alipore central observatory. The five officers last mentioned are half-time officials, who hold other appointments in the Educational or Telegraph departments[1].

India not an isolated meteorological area. For many years the Indian region, including India proper, Burma, the Arabian Sea, and the Bay of Bengal, was considered as an independent meteorological area, in which the weather was supposed to be determined chiefly, if not solely, by the conditions within that area. It was assumed that India was protected on the north by the lofty barrier of the Himālayas, and on the west by the moderately high range of the Sulaimāns, from the cold winds coming from northern regions, and that it was only exposed to the influence of equatorial sea currents. The presence of this northern mountain barrier does undoubtedly exercise a very considerable influence on the meteorology of India and more especially of the Indo-Gangetic plain; for a comparison of the temperature data of Northern India with those of the south and centre of the United States in the same latitudes indicates that the intervention of the Himālayas increases the temperature of the Indo-Gangetic plain from 3° to 5° above what it would have been if a low-level plain had extended northwards to the Arctic regions. Nevertheless, as will be seen later on, meteorological conditions in India generally are very largely determined by outside influences.

Physiographic features of India. The physiographical and geographical features of India are of great importance, in so far as they modify more or less considerably the lower air movement, and hence the distribution of temperature, pressure, humidity, and rainfall; and it is necessary to bear them in mind in any scientific discussion of the meteorological conditions and actions of that country. India is the middlemost of three great Asiatic peninsulas which project southwards into the Indian Ocean, and which are more or less dependent on that ocean for their broader meteorological features. It consists of a peninsula proper (to the south of latitude 22° N. or the Tropic of Cancer), and of a broad low alluvial plain the axis of which runs east and west.

[1] *Note by Editor.*—The constitution and present efficiency of the Indian Meteorological Department are due mainly to two men who have successively been at its head—Mr. H. F. Blanford and Sir John Eliot, K.C.I.E., the latter of whom has contributed the material for the present chapter.

The Peninsula is of comparatively low elevation and has a backbone of hills, near the west coast, from which the land slopes slowly eastwards[1]. To the north of the Peninsula is the low plateau of Central India, gradually falling to the extensive Indo-Gangetic plain, which nowhere rises, except in the immediate neighbourhood of the hills, above 800 feet. To the north of this extensive plain is the lofty continuous barrier of the Himālayan mass, the central axial range of which averages over 20,000 feet in elevation. Farther north is the elevated Tibetan plateau, an extensive area 2,000 miles in length from east to west and 200 to 500 miles in breadth from north to south, averaging over 10,000 feet in altitude. The continent thence falls northwards by a succession of slopes to the Arctic Ocean, to which it presents a vast low unbroken plain similar in general character to that of the corresponding plain in North America. Any general air movement on the Tibetan plateau would, if it extended into the plains of Northern India, have to rise 10,000 feet and then be precipitated in cascade form over the Indian hills. There is no evidence of any such general movement in the lower atmospheric strata. Actual observations indicate that the air motion over the Western Himālayas is mainly an interchange between the hills and plains due to local actions and conditions, and is not the continuation of general air movements over Central Asia, or the Indian Ocean and its two arms, the Arabian Sea and the Bay of Bengal. Any such general air movement is confined to the middle and higher atmospheric strata.

Again, the north-west frontier of India proper consists of a series of hill ranges running north and south, forming the escarpment of a plateau stretching westwards for at least 1,000 miles into Western Persia. The average elevation of these ranges north of Jacobābād is at least 6,000 feet, and of the greater part of the plateau to the west 4,000 to 5,000 feet. The lower air movements upon that plateau are not at any period of the year continued over the frontier ranges into Northern India. There is a drift down the passes, but it is insignificant. Hence the important conclusion that India is, in its lower air movements, cut off towards the north, north-east, and north-west. Northern India is at one season the goal of the sea winds that blow in the lower strata, and at another season the source of the land winds that blow from it to the neighbouring seas; but the origin of these movements is not to be found

[1] It is this tract which is hereafter referred to as 'the Peninsula.'

directly in the heating and cooling of the large central area of Central Asia, as has been stated by some meteorologists.

Outside influences which affect Indian meteorological conditions.

It will, however, be shown later on that the cold weather rainfall in India is largely dependent upon storms which originate in the *higher* atmosphere to the north-west of India, and that the distribution of the monsoon rains is in part dependent upon conditions in the distant Indian Ocean, and in part upon conditions in East Africa, the Persian area (probably), and perhaps to a slight extent Central Asia.

The alternation of seasons known as the monsoons the primary fact of Indian meteorology.

The primary fact in the meteorology of India is the alternation of seasons known as the south-west and north-east monsoons. If the Indian Ocean extended northwards over the whole or greater part of Asia, the air movement, and meteorological conditions generally, over the area between 35° S. and 35° N. lat. would be similar to those obtaining in the corresponding belts of the Atlantic and Pacific Oceans. North-east winds would blow steadily and permanently over the northern, and south-east winds over the southern half. Between these two systems of winds there would be a narrow belt near the equator, which would move slightly northwards or southwards during the year, and in which variable winds, with frequent squalls and showery weather, would prevail. These wind systems in the Pacific and Atlantic Oceans are due to the large and permanent differences of temperature between the tropical and polar regions. Over the belt of high temperature in these oceans near the equator there is a more or less continuous ascensional movement, and an outflow in the upper atmosphere northwards and southwards with an indraught from north and south in the lower strata. Pressure is lowest in the area of squally weather and variable winds near the equator, and increases northwards and southwards to about 35° or 40° N. and S. lat., near which latitudes high-pressure belts or narrow elongated areas lie over these oceans. These pressure features are as permanent as the trade winds.

The presence of the Asiatic continent, extending from the neighbourhood of the equator northwards, modifies the air movement and pressure conditions very largely in the Indian Ocean and seas, and converts, in the northern portion, a permanent into a periodic, or monsoon, air movement. During one period of the year Central and Southern Asia is much cooler (from 15° to 25° in the winter months), and during the remainder of the year its temperature is considerably higher (probably from 10° to 15° in the summer months), than the Pacific and Atlantic Oceans in the same latitudes. These are

the fundamental facts of temperature that underlie the explanation of the monsoons in India.

North-east and south-west monsoons.

The north-east monsoon is a season of winds of continental origin, and thus of great dryness except where they have passed over some extent of sea, and hence in India of clear or lightly-clouded skies and of light occasional rain, due either to feeble depressions or to local disturbances. The south-west monsoon, on the other hand, is a season of winds of oceanic origin, of high humidity, and of frequent and heavy rain over nearly the whole area. The average annual rainfall of India, as determined from the returns of about 2,000 stations, is 45 inches, of which nearly 90 per cent. falls during the south-west monsoon. From this point of view the terms dry and wet monsoon seem to be more appropriate, as suggesting the most prominent and important feature of the seasons in the land area of India. The dry monsoon, which lasts from about the middle of December to the end of May, may be divided into two periods, one of comparatively low, and the other of increasing and high, temperature. The former, the cold weather of Northern India, includes the months of January and February, and the latter extends from March to May. The wet monsoon may also be subdivided into two periods. The first, from June to September, is the monsoon proper, when general and heavy rain falls occasionally or frequently in nearly all parts of India. The second is the retreating monsoon period, when the area of rainfall contracts southwards, and the intensity and volume of the fall diminish, until the humid currents pass out of the Indian land and sea areas and withdraw to the equatorial belt: this period extends from October to December.

Subdivision of each monsoon into two periods.

Pressure conditions in Asia and Indian Ocean during cold weather period.

The north-east monsoon air movement is fully established over the Indian land and sea areas by the beginning of January, when temperature is lowest in the Asiatic continent. A belt of high pressure and anti-cyclonic conditions then stretches from the West Mediterranean to Central Asia and North-east China. This corresponds to the belts of high pressure in about latitude 30° N. in the Pacific and Atlantic Oceans, but lies farther north. Pressure decreases southwards to a belt a little to the south of the equator, and thence increases again to a broad belt stretching from South-west Australia across the South Indian Ocean to the Cape. The northern belt of high pressure appears to separate completely the region traversed by the storms of Northern Europe (most of which enter from the North Atlantic) from the areas of the local storms of the Mediterranean Sea, Persia, and India, and limits to the north

what may be termed the Indian monsoon region. The pressure conditions evidently accompany and determine northerly winds (deflected to north-east in consequence of the earth's rotation) in the Indian seas, and south-easterly winds in the centre of the Indian Ocean. The winds in the land area are modified by the trend and elevation of the mountain ranges, and by the direction of the mountain valleys. Temperature begins to rise in general in the month of February over the Asiatic continent, but the changes are usually small until the end of that month. Hence the normal air movement and pressure conditions are practically the same during these two months over the whole area between lat. 40° S. and 35° N., and the air movement in that large area virtually consists of two independent circulations. The rough sketch below shows the general character of the

VERTICAL SECTION ALONG MERIDIAN OF 70° E. IN JANUARY

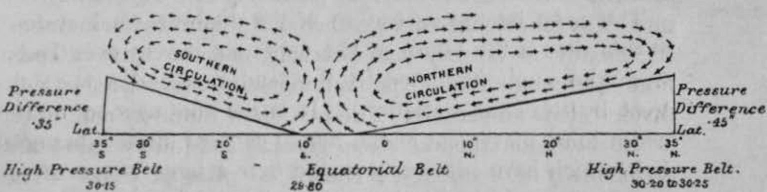


FIG. 1.

pressure conditions and air movements in these areas. The meteorology of India during this period is only concerned with the actions and changes in the northern circulation. The Central Asia high pressure or anticyclone, although intense, is ineffective so far as the *lower* air movement in India is concerned, as it not only lies over very elevated ground but is shut off from India by the Himālayan barrier range.

Clear skies, fine weather, low humidity, large diurnal range of temperature, and light land winds are the characteristic features of the weather in India during this period. These conditions are as a rule initiated in the Punjab in the beginning of October, extend slowly eastwards and southwards, and finally prevail over the whole Indian land and sea area to the north of lat. 8° N. before the end of December. The months of November and December are, on the whole, the pleasantest of the year in Northern India. The air movement in Northern and Central India is from the west down the Gangetic plain, Sketch of air movement in India during cold weather period.

recurving across Bengal through north-west and north, and in the Bay of Bengal, where it is from north-east to east. This latter movement is continued across the Peninsula from the east, and passes out into the Arabian Sea. The west coast districts from Gujarāt southwards and the adjacent sea area are, however, protected from this general movement by the Western Ghāts, and hence light to moderate land and sea breezes obtain in a well-marked form in these districts. The most noteworthy feature of the air movement in India at this time is that it is from practically opposite directions in Northern India and in the Peninsula, viz. from the west in the former and from the east in the latter area. The intermediate belt, which includes the greater part of Khāndesh, Berār, and the southern half of the Central Provinces, is, as might be expected under these conditions, a region of light unsteady variable winds. It is also the seat of the largest deviations from the normal weather conditions (more especially of temperature), to which attention will be directed later.

The most interesting feature of the northern wind system at this time is the return of the upper air current over India from the south (deflected to the south-west and west-south-west by the earth's rotation). It is the continuation of the ascensional movement of the humid currents in the equatorial belt, which have previously passed over a large extent of sea surface, but which, by the action of ascensional movement, have been deprived of a considerable portion of their aqueous vapour in that belt. This current is not fully established until the end of December, by which time the circulation of the south-west monsoon has been fully replaced by that of the north-east monsoon.

Storms of the cold-weather period—phenomena of the upper current.

These facts explain to some extent the character of the storms and disturbances of the period in Southern Asia. A succession of shallow storms passes eastwards across the Persian area and Northern India during this period. These storms are not the continuation of European disturbances, and are land-formed. The precipitation accompanying them is small in amount over the greater part of the area they cover, but is very large on the higher elevations of the mountain ranges to the north, including the Hindu Kush and Himālayas. A unique feature of these storms is the formation of brief subsidiary or secondary depressions in the Punjab, accompanied by moderate to heavy rain in the plains, and by violent gales and heavy snowstorms in the middle and higher Western Himālayas.

These storms are attended with remarkable temperature effects. Temperature usually rises very considerably in front of them, owing in part to the presence of cloud which diminishes largely the fall of temperature by night, and in part to the shift of winds to easterly and southerly directions. In the rear of the storms unusually dry clear weather obtains as a rule, with stronger and cooler westerly winds than usual. This change is, of course, emphasized by the previous rise of temperature over the same area when it was in the advancing quadrant of the storm. Temperature occasionally falls as much as 20° or even 30° in forty-eight hours in Baluchistān and Northern India owing to the passage of these warm and cold waves. It should, however, be noted that these temperature changes are more directly related to the extent of snowfall in the neighbouring mountain and plateau areas than to the intensity of the storms.

The few cloud measurements that have been taken at Allahābād and Simla during these storms establish that the cloud, and hence the field of condensation, in these storms is at an elevation of 15,000 to 20,000 feet. The distribution of the precipitation, and the occurrence of stormy winds and weather, not in the plains, but in the mountain districts of Northern India, indicate clearly that the storms are disturbances in the upper humid, and not in the lower dry land, current. The great majority of them originate either over the Syrian desert area or over the Persian plateau, and usually begin to affect Baluchistān and North-western India in December. They are, in their full development, a phenomenon of north-east monsoon or cold-weather conditions only, and are, compared with the storms which visit Northern Europe at this time, very feeble disturbances. The barometric depression in the primaries rarely exceeds two-tenths, and in the secondaries five-tenths, of an inch. The number and character of these storms vary very largely from year to year. The conditions determining these variations have not yet been fully investigated; they appear to have no relation to the local conditions in the lower atmosphere over India.

Weather in India during cold-weather period.

In Northern and Central India periods of bright sunny weather, with clear or lightly clouded skies, alternate with periods of cloudy showery weather accompanying the passage of the shallow extensive cyclonic or cold-weather storms of the period; and light to moderate showers fall in the plains of Northern India during the advance or passage of the storms. In Rājputāna, Central India, and the Central

Provinces the rain is much less frequent and more local in occurrence, and usually accompanies thunderstorms. Occasionally severe hailstorms occur during the passage of these cold-weather storms across Rājputāna and Central India, and do much damage to the poppy and other crops. The influence of these storms rarely extends to the south of the hill ranges lying across the head of the Peninsula. On the other hand, the north-easterly to easterly winds which blow across the Coromandel coast districts are more or less largely charged with vapour, due to their passage over a considerable extent of sea area in the Bay, with the result that some cloud prevails in Southern India during this period, especially over and near the hills. The intermediate belt, including the Konkan and the Deccan, has less cloud than any other part of India at this time. The cool north-west winds in the rear of the storms advancing from Persia and passing over Northern India occasionally extend across the north-east of the Arabian Sea, and reduce temperature considerably as far south as Goa and Kārwār.

Precipitation of the cold-weather period.

During this season the rainfall is very small in amount over Lower Burma, and practically *nil* over the greater part of the Peninsula. The rainfall in Northern India is greatest in the submontane districts and decreases in amount with increase of distance from the hills. The chief feature of the precipitation is the heavy snowfall in the Western Himālayas and the higher mountain ranges of Afghānistān and Baluchistān. It increases rapidly with elevation and probably exceeds on the average 30 feet at 15,000 feet of altitude, and varies between that amount and at least 60 to 100 feet over the higher ranges.

Fine weather prevails generally in Southern India at this period; but occasional showers, frequently accompanying thunderstorms, are received in the coast districts, and on the Palni, Nīlgiri, and Anaimalai hills, usually immediately after the breaking up or disappearance of the more vigorous cyclonic storms of the period in Northern India, when strong north-east winds flow down the Bay and are continued as easterly winds across the Coromandel coast. This is, it may be pointed out, one of the many examples of a marked contrast of conditions between northern and tropical India. Higher temperature or cloudy weather in one area often accompanies lower temperature or weather finer than usual in the other.

It has been pointed out that there is a debatable tract between the areas of westerly winds in Northern and Central

India and of easterly winds in the Deccan. During the period from November to February the rainfall in this tract, which includes Khāndesh, Berār, and the southern half of the Central Provinces, is usually very scanty. In normal years heavy fogs or mists occur nightly, contributing largely to the progress of the great wheat crops of these districts; but in years when the cold-weather rains are late and scanty, temperature rises very largely above the normal in this area and fogs are then comparatively rare.

Meteorology of the second half of the dry or north-east monsoon.

The second half of the dry season includes the months of March, April, and May. During this period increase of temperature in the northern region, more especially in the Indian land area, accompanies a fairly continuous decrease of pressure; and decrease of temperature in the southern region, including the Indian Ocean and adjacent land areas of Africa and Australia, causes a slight but continuous intensification of the southern anticyclone referred to on page 110. These pressure changes accompany corresponding changes in the two air movements. The south-east trades movement increases in intensity and volume, and the north-east trades movement not only decreases, but is to some extent broken up, by the establishment of local circulations in India, and perhaps in Arabia and East Africa. An important feature in connexion with these changes is a slow transfer northwards of the equatorial low-pressure belt. This northward advance is probably due chiefly to the strengthening of the southern, and in slight part to the decrease of the northern, circulation. It is noteworthy that during this period the area of general rainfall due to the south-east trades is transferred northwards from South-east Africa to the Equatorial Lakes region of that continent.

The conditions existing during the first half of the dry monsoon season begin to be modified over the whole land and sea area of India in the latter half of March, owing to rapid increase of temperature. North-east winds continue in the Arabian Sea and Bay of Bengal, but fall off in strength, and in April and May light winds obtain in the centre and south of the two seas, more especially in the Arabian Sea. Very large and important changes in the pressure, temperature, and humidity conditions are initiated in the interior of India during these two months. Temperature increases rapidly and steadily[1], and pressure diminishes *pari passu*, over the heated

[1] It is most satisfactory, on the whole, in discussing the meteorological conditions and changes accompanying the prevalence of increasing and

land area, owing to the transfer of air to neighbouring cooler regions, more especially the sea areas to the south. India thus becomes a low-pressure area relative to the adjacent seas. The depression is very slight at first, but increases in intensity with the advance of the season. The most important local features in this general depression are the formation and development of a deepish low-pressure focus or sink in the hottest area, including Upper Sind and the adjacent districts of the Punjab and Rājputāna, and the formation of a shallow depression in Chotā Nāgpur. There is thus increasing local indraught from the adjacent seas across the Bengal and Bombay coasts, which is, however, only clearly marked over comparatively narrow belts round the coasts landwards and seawards. These belts slowly increase in width with the season; but in the Arabian Sea the belt, even in May, probably does not at the utmost extend more than 300 miles seawards, thus leaving a large area of light northerly or variable winds in the centre and south of that area. In the Bay of Bengal, on the contrary, the local sea winds extend in May over the greater part or the whole of its area, in consequence chiefly of its comparatively small extent. These changes convert the air

Changes of pressure conditions and air movement accompanying local increase of temperature in Indian land area.

high temperature to consider the maximum day temperature as the best indication of the intensity of the thermal conditions and actions. The following gives a brief statement for the months from February to June of the maximum day temperature conditions in the plains of India.

In *February* the mean maximum temperature ranges from a mean of 66° in the Northern Punjab to one of 90° to 95° in the Deccan and interior of Southern India. It increases in *March* to about 100° in the latter area, and ranges between that amount and 76° in the Northern Punjab. In *April* it ranges between 100° and 105° over by far the greater part of the interior of India except the north-west and submontane districts. The area of greatest day temperature is transferred in this month to the Central Provinces and Western Rājputāna. In *May* the mean maximum day temperature varies between 105° and 110° over the greater part of the interior, and the thermal focus, as the area of greatest temperature was termed by Mr. Blanford, now includes Upper Sind, the South-western Punjab, and Rājputāna, in parts of which it slightly exceeds 110°. In *June* the highest mean maximum temperatures are, as in May, between 105° and 110°, but occur in a comparatively small area including the Western and South-western Punjab and Upper Sind.

The hottest area in India just before the invasion of the south-west monsoon currents is Upper Sind and the South-western Punjab, as represented by the observatories at Jacobābād and Montgomery. The hottest period is usually the last week of May or the first week of June, just before the first advance of the Bombay monsoon current up or across the western coast. The highest maximum day temperature hitherto recorded in India is 126°, at Jacobābād, on the 12th of June, 1897.

circulation in India and the adjacent seas from a general into a local movement, marked by strong hot winds down the river valleys in Northern India as well as by the strong sea winds above mentioned. It is no longer part of the previously established north-east trades, nor is it, as some have maintained, the commencement of the south-west monsoon. The period is undoubtedly a transition from the general air movement of the north-east to that of the south-west monsoon, but the final transformation occurs under conditions, and in the manner, explained later.

Storms of the hot-weather period.

In normal years, India is not disturbed during the hot weather months (March to May) by storms appearing in Central or Western Asia [1], for this is the only period of the year, it should be remembered, in which India is, to a large extent, an independent meteorological area. It is in consequence of this isolation that the storms of this period are local in character. They are due to various large actions and contrasts of conditions accompanying high temperature, large diurnal range of temperature, and great contrasts of humidity. These storms all belong to a class which may be termed hot-weather storms. They include the dust-storms of the dry heated interior [2] (the Punjab, Sind, Rājputāna, and the Gangetic plain), and thunderstorms in the regions in which there is more or less interaction between the damp sea winds and the dry winds from the interior, viz. Assam, Bengal, Burma, the west coast districts, and the Deccan. Hailstorms are more common in Assam than in any other part of India. They also occur frequently in Central India, and occasionally in Bombay, Rājputāna, the United Provinces, Bengal, the Central Provinces, and Sind. They are of very occasional occurrence in Upper Burma, Hyderābād (Deccan), and Kāthiāwār, and rarely, if ever, occur in Mysore, South Madras, Malabar, the Konkan, and Lower Burma. The interaction of the dry and damp winds is, in Bengal and Assam, supplemented by the action of the hills in giving rise to vigorous forced ascent, and these thunderstorms, or 'nor'-westers' as they are locally called, are of frequent occurrence, and occasionally of great violence and intensity. Sometimes they develop into tornadoes, the most

[1] Sometimes under very special conditions, as in the year 1903, a series of cold-weather storms continues to cross Baluchistān and Northern India in March.

[2] These are sometimes, but rarely, accompanied by destructive hail. In the Morādābād hailstorm of April 30, 1888, at least 230 persons were killed.

intense form of small revolving whirls. These are rarely more than a few hundred yards in diameter, but advance rapidly, overturning and destroying houses and trees, and causing great destruction of life and property. Their path of destructive violence is seldom more than 5 to 10 miles in length. They are comparable in violence and intensity with the tornadoes of certain districts of the United States. The rainfall due to these hot-weather storms is very important in North-eastern India, especially in Assam, where it is of great service for the tea crop.

These storms, which are peculiar to the hot weather, are evidently due to the vigorous convective air movements of the period, and usually occur in the afternoon hours when these movements are strongest. Their frequency and strength increase, as might be expected, with the advance of the season, and with the increasing intensity of the thermal conditions and actions. This is very clearly shown by the following data for the rainfall of the period in Bengal and Assam :—

Division.	Normal Rainfall (inches).		
	March.	April.	May.
Assam—Valley	3.56	8.09	12.03
Assam—Surmā	7.75	13.42	18.00
North Bengal	1.26	3.97	10.65
East Bengal	2.31	4.24	10.45
Deltaic Bengal	1.44	2.31	6.16

The amount of aqueous vapour in the air increases slowly, but fairly steadily, during this period, owing to the increasing influence and extension into the interior of the sea winds. This increase is most marked in the coast districts. In the interior the humidity percentage decreases considerably in consequence of the rapid increase of temperature, and the air is as a rule exceedingly dry in the afternoon hours during the months of April and May.

The wet season or south-west monsoon.

We have next to deal with the south-west monsoon. In the first or cold-weather period the weather in India is mainly determined by continental, and in the second or hot-weather period by local, conditions. During the south-west monsoon the weather is determined chiefly by oceanic conditions, which we have now to consider.

The first portion of the wet season, from June to September, witnesses the extension of the south-west monsoon currents over the whole of India and their persistence during these

months as rain-giving currents. This is the season of the south-west monsoon proper. It is the most important season of the year, as it is upon the amount and distribution of the rainfall of this period that the prosperity of at least five-sixths of India mainly depends.

Accompanying the rapid increase of temperature in the Asiatic land area in May, pressure generally decreases, so that at the end of May the Asian winter anticyclone has been replaced by a deepish low-pressure area, the axis of which stretches from the Sūdān to Sind and Western Rājputāna and thence to Bengal, and is hence farther south than the median line of the winter anticyclone. A graphical representation of the chief pressure conditions in India and the Indian Ocean in May is given below. As compared with that given on p. 111

VERTICAL SECTION ALONG MERIDIAN OF 70° E.
IN MAY

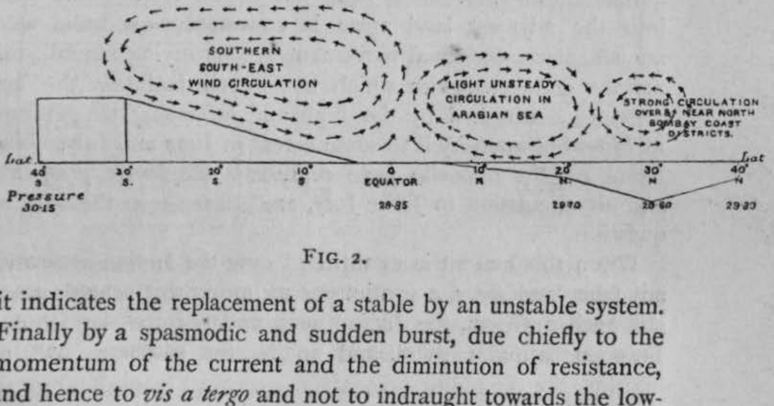


FIG. 2.

it indicates the replacement of a stable by an unstable system. Finally by a spasmodic and sudden burst, due chiefly to the momentum of the current and the diminution of resistance, and hence to *vis a tergo* and not to indraught towards the low-pressure area in India, the equatorial belt closes up, and the south-east circulation extends northwards across the equator into the two areas of the Arabian Sea and the Bay of Bengal, whence it advances more or less quickly into the neighbouring land areas of Burma, India, and Abyssinia.

Extension of the south-east trades across the equator into the Indian sea and land areas.

This advance in many respects resembles, on a large scale, what the 'bore' in a river like the Hooghly is on a small one. The front of the advancing current is in each of the sea areas invariably an area of very disturbed weather, strong winds, and frequent heavy rain squalls. Often a cyclonic storm forms in this area and is when it occurs the most characteristic feature of the advance. The storms in the

Cyclonic storms in the Arabian Sea.

Arabian Sea usually advance parallel to the coast until they reach the latitude of Bombay, when they generally recurve to the west and march to the Arabian coast, where they break up. Occasionally they form farther west and advance past Sokotra into the Gulf of Aden. These storms are on the whole the most dangerous that are encountered by mariners in the Arabian Sea. The most disastrous in recent years was the Aden cyclone of May 30 to June 3, 1885, in which the English SS. *Speke Hall*, the French man-of-war *Renard*, the German corvette *Augusta*, and numerous native craft were lost with all hands. The storms in the Bay of Bengal, unlike those of the Arabian Sea, advance landward and usually strike the Bengal or Orissa coast and thence march in directions between north and west, giving more or less general rain [1]. If the humid currents are strong they quickly spread over the whole of India, and the transformation from the hot weather to damp cloudy rainy weather is effected in a very short period. During the next three or four months the horizontal air movement over the Indian Ocean and seas into the adjacent land areas is converted over India into an irregular ascensional movement accompanying rainfall, the actions connected with which not merely maintain the low pressure established by the high and increasing temperature in May, but intensify it to some extent in June and July. The figure on the opposite page represents the lower gradients and air circulation in June, July, and August over the area in question.

When this current is established over the Indian seas and adjacent land areas, a continuous air movement extends over the Indian Ocean, the Indian seas, and adjacent land areas between latitudes 30° S. and 30° N., the southern half of

[1] It may also be noted that storms occasionally form in the Bay of Bengal and the Arabian Sea *before* the establishment of the monsoon currents in those areas. They are initiated under different conditions, but are on the whole similar in character, to the October cyclones. These storms are usually generated in the centre of the Bay after a period of light unsteady winds and hot sultry weather, and hence probably of the accumulation of much aqueous vapour in the air by evaporation. They at first advance very slowly, but increase considerably in velocity as they approach the coast. They usually move westwards to the Madras coast or north-north-eastwards to the Pegu or Arakan coasts. It is very remarkable that these storms sometimes form in several years in succession about the same time and advance along the same route. For example, one such storm has formed during four out of the five years ending with 1902 in the last week of April or the first fortnight of May and has marched along the same general track to the Burma coast.

which is the south-east trades and the northern half the south-west monsoon current. The strength of this movement differs very considerably in different parts of its area of extension, owing to various causes. The most important fact is that it is a continuous horizontal air movement in the lower atmosphere that occurs mainly over an extensive tropical oceanic area, in the greater part of which it is passing from cooler to warmer areas and in which weather is generally fine with clear or lightly clouded skies. Hence when it enters the Indian seas and approaches the coasts of Southern Asia the air is highly charged with aqueous vapour.

The south-east trades, previous to their extension across the equator, are largely directed to the African coast, and give more or less general rain, during the dry monsoon period of India, in South and East Africa. During April and May the rainfall occurs most largely in the Equatorial Lakes area and

Complete field of extension of the south-west monsoon currents.

VERTICAL SECTION ALONG MERIDIAN OF 70° E. IN JULY

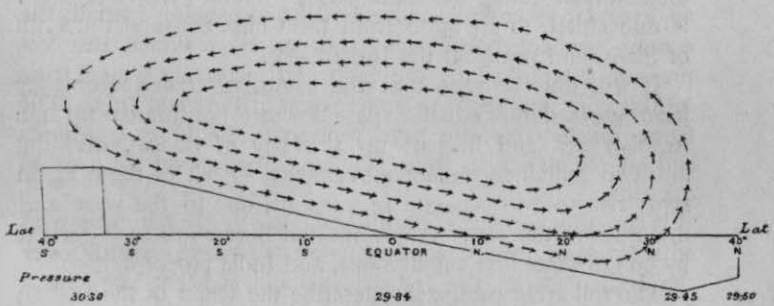


FIG. 3.

adjacent districts. This rainfall produces the first seasonal rise of the Nile in May and June. The extension of the south-east trades as south-west winds over the Arabian Sea is followed by a diversion of a part of the monsoon current to Abyssinia and the Sūdān. The rainfall in the mountain districts of Abyssinia is similar in period and character to that of Northern India. Sir W. Willcocks estimates that an average of 60 to 70 inches falls over that area from June to September. This gives rise to a much higher and greater flood in the Nile than does the rainfall in Central Africa. The Nile floods hence reach their culmination in September.

Arabia, so far as is known, shares only slightly in the Arabian Sea monsoon current, which is chiefly deflected eastwards over the centre and hence parallel to the Arabian coast. Some of the higher regions in Southern Arabia, more especially Yemen, receive moderate rain during the period. Persia, Afghānistān, and Baluchistān are practically outside the sphere of the monsoon currents.

The Arabian Sea monsoon current is mainly determined to India, across the Bombay coast. The Bombay current prevails exclusively over the Peninsula, Central India, Rājputāna, and Northern Bombay. Another portion of the monsoon current passes up the Bay of Bengal, and part of it enters India proper, giving rain to Assam, Bengal, and the Gangetic plain. The volume of the Bombay current is probably three times as great as that of the Bengal current. The remaining portion of the current in the Bay passes from the Andaman Sea across the Lower Burma coast and up the river valley of the Irrawaddy, giving frequent rain to the whole of Burma. Siam and South China receive most of their rainfall during the same period; but this, it would seem, is due chiefly to an influx from the China Sea and the Gulf of Siam, and not from the Indian seas.

It will thus be seen that the south-east trades, after they have crossed the equator, pass in part northwards up the Arabian Sea and in part up the Bay of Bengal, dividing into two semi-independent movements. Each of these again gives rise to two separate movements, one to the west and the other to the east. Abyssinia and Burma are each served by one of these four subdivisions, and India proper by two.

Bay of Bengal current.

The following paragraphs describe the action of the Indian monsoon currents in greater detail. The current in the south of the Bay of Bengal is from west-south-west to south-west, and is therefore at this stage largely directed towards Burma and Tenasserim; and probably at least one-third of its volume proceeds to that area, and is either forced across the Tenasserim hills or passes up the Irrawaddy valley. The remaining portion advances up the Bay and is deflected westwards by the action of the Arakan hills, with the result that at the head of the Bay the mean direction of the air movement is from south-east and south. The advancing current chiefly crosses the coast between Chittagong and Purī, and comes almost immediately under the influence of the Assam hills and the Eastern Himālayas. That portion of the current which passes into the *cul de sac* formed by the Assam and Chittagong hills

is forced upwards, and gives excessive rain (the heaviest probably in the world) to the southern face of the Assam hills. The remainder of the current is deflected westwards, owing largely to the action of the lofty barrier of the Himālayas, to the lower ranges of which it gives almost daily rain along its whole length from Sikkim to Kashmīr. The field of this portion of the monsoon current is therefore Assam, Bengal, and the greater part of the Indo-Gangetic plain. It is more effective as a rain-distributing current than the Bombay current, as it is not directly impelled against and across a line of hills, and forced by ascent to part with the greater part of its moisture before reaching the interior, but advances up a broad river plain, the elevation of which increases very slowly with distance from the sea.

Arabian Sea current.

The greater portion of the Arabian Sea current on reaching the Bombay coast is directed from west-south-west to west against the west coast districts. Over a large portion of that area it meets with an almost continuous hill range, from 3,000 to 6,000 or 7,000 feet in elevation and rising abruptly from the coast, and is forced across in part by the momentum of the whole current. This forced ascent cools down the air considerably, and gives rise to frequent and very heavy rain upon these hills. Heavy rain, too, falls in the low coast districts, the total averaging roughly 100 inches, nearly the whole within about four months. The current, after depositing the greater portion of its aqueous vapour in the coast districts and the western face of the Ghāts, advances across the Peninsula, giving strong winds but only occasional rain to the Deccan, and passes out into the Bay of Bengal, where it mixes with the Bay current, giving rise to occasional squalls.

The northern portion of the west coast current, which crosses the Kāthiāwār, Cutch, and Sind coasts, passes over the sandy plains of Western Rājputāna, and gives little rain, except in the coast districts, until it reaches the Arāvalli hill range. It thence passes on north-eastwards and northwards, being deflected from the hottest and driest area (the Sind permanent low-pressure area of the period) by the action of the earth's rotation, and reaches the Eastern Punjab, where it intermingles with the current from the Bay and is in part deflected westwards, and in part forced upwards by the Himālayan range, where the two currents combine to give moderate to heavy rain in the Eastern Punjab, Eastern Rājputāna, and the Western Himālayas.

An important feature of the period, not yet noticed, is the

debatable area in the south of the Indo-Gangetic plain between the independent fields of the two currents. It usually stretches from Sirsa, through Agra, Allahābād, and Hazāribāgh, into Orissa, and may be termed the monsoon trough of low pressure. It is characterized by lower pressure, and by the prevalence of much more variable and unsteady but stronger winds, than the areas immediately to the north or south. A very marked tendency exists for cyclonic storms forming in the north of the Bay during the period to advance along this trough. It is mainly due to this that the rainfall is locally heavy in the rice-growing districts of the Central Provinces.

Monsoon trough of low pressure.

Date of establishment of wet monsoon in different parts of India.

The normal dates on which the monsoon currents advance into the larger Provinces of India are given below:—

Area.	Normal Date of the Commencement of the South-west Monsoon Rainfall.
Malabar	June 3
Bombay Coast	„ 5
Deccan	„ 7
Central Provinces	„ 10
Central India	„ 15
Rājputāna	„ 15
Bengal	„ 15
Bihār	„ 15
United Provinces, East	„ 20
United Provinces, West	„ 25
Eastern Punjab	„ 30

The dates do not, as a rule, vary much in the coast districts, but range over a considerable period in North-western India. The monsoon is usually established over the whole Indian area by the end of June. July and August are the months of greatest extension of the currents to the northern limits of the Punjab, and of heaviest and most general rain. The strength of the currents, and the accompanying rainfall, begin to diminish in the first or second week of September and decrease rapidly during the latter half of the month.

Pulsatory character of the rainfall of the period.

The period of about three months during which the monsoon usually obtains its full strength is, however, not one of continuous rain in any part of India. More or less general rain is received during periods varying very considerably in length, with intervals of fine weather and passing clouds in the interior and showery weather in the coast districts. In other words, bursts of general rain alternate with breaks, partial or general as the case may be. This is due to what may be described as the self-feeding actions accompanying rainfall. Some ascensional

movement is requisite to cool the air in order to give rise to condensation and rain. The process of condensation releases energy, which strengthens the ascensional movement and hence up to a certain point increases the rainfall. It however drains and partially exhausts the atmosphere of aqueous vapour. The rainfall then diminishes in amount, and *pari passu* the ascensional movement decreases, until the rainfall ceases or has become local in character and distribution [1]. A short period of lighter winds of indraught follows, with a slow accumulation of energy, in the humid currents over the south and centre of the Indian seas. This is followed by a repetition on a small scale of the actions accompanying the first great advance of the monsoon. In other words, the strong humid winds in the Bay tend to press forward by their momentum, and squally rainy weather sets in over the front of the current. A cyclonic storm forms, and the storm, with the strong humid winds in its rear, advances landwards and gives another burst of heavy and more or less general rain. The pulsatory character of these actions and of the rain precipitation is one of the important features of the monsoon period.

Cyclonic storms of the rainy season in the Bay of Bengal.

The majority of the storms which form in the Bay of Bengal during this period rarely develop so far as to have an inner calm central area, and only about one storm in four is of sufficient intensity to give winds of force 10 (gale) or upwards [2]. They are chiefly remarkable for the rapidity with which they form and begin to move landwards, for the heavy rain they distribute to the belt they traverse, and for the general moderate rain that follows during a few days over the greater part of Northern India. They are thus of great importance in the economy of the season, as they not only modify considerably the rainfall distribution, but are apparently an essential element in the dynamics of the current for the production of general rainfall. In some parts of the interior, rainfall during the wet monsoon occurs only in connexion with these cyclonic storms. The great majority of these storms advance far into the interior, into Rājputāna or the Punjab. In fact their vitality is one of their most characteristic features. Their tracks depend largely upon the distribution of pressure at the time of their advance. They almost invariably march in a west-north-westerly direction, except at the commencement and near the end of the period,

[1] There is a tendency to increased rain in the Deccan and the southern districts during these periods, an example of the opposition of conditions and actions that frequently subsists between Northern and Southern India.

[2] Beaufort notation.

when they occasionally advance northwards into Bengal. The great majority form in the north of the Bay, and occasionally, under special conditions, over South Bengal, where their origin is associated with concentrated heavy rain.

Normal rainfall—May to October.

The following table shows the general distribution of rainfall month by month from May to October. These are the averages of a large number of stations not equally distributed, values which are only approximate but sufficiently exact for the purpose intended.

	Inches.
May	2·60
June	7·10
July	11·25
August	9·52
September	6·78
October	3·15
Total	40·40

Humidity and temperature conditions during the south-west monsoon.

An important feature of the rains is the marked tendency to uniformity of temperature, cloud, and humidity conditions over by far the greater part of India. This will be seen from the following data for twelve representative stations in India for the month of July:—

Station.	Mean temperature.	Mean (8 a.m.) humidity.	Mean (8 a.m.) cloud amount. (0=clear, and 10=overcast, sky.)
	°	Per cent.	
Lahore	90·0	70·5	4·3
Karāchi	85·6	81·5	7·3
Jaipur	85·9	75·9	6·8
Allahābād	85·5	83·7	8·2
Calcutta	83·3	88·5	8·4
Sibsāgar	84·0	92·8	8·9
Nāgpur	81·5	83·4	8·4
Bombay	81·0	86·2	9·0
Rangoon	80·6	93·8	9·0
Sholāpur	80·6	72·4	8·1
Trichinopoly	87·7	62·3	7·1
Madras	87·2	68·7	7·4

Variations of the strength of the south-west monsoon currents related to corresponding variations in the

As the south-west monsoon currents are the direct continuation of the south-east trades, it is *a priori* probable that they will more or less reproduce any large variation in the strength and character of the latter. The data for estimating the intensity, volume, or humidity of these two great currents are, however, too few and uncertain to be of any value for detailed comparison except as regards the accompanying rainfall. The experience of the past ten years has shown that there

is from this standpoint a close connexion. The period 1895–1902 was one of almost continuously deficient rainfall in India, and of severe droughts in 1896 and 1899. The same period was notoriously one of scanty rain and droughts in Australia, and of severe droughts in different parts of South and East Africa. Mauritius suffered from drought in the years 1896–97 and 1899–1900, or immediately subsequent to the scanty rainfall in India that brought on the famines of 1897 and 1900. It is not possible to make a more exact comparison at present; but the evidence is sufficiently strong to justify the conclusion that deficient rainfall in the south-east trades region in the period November to April is preceded or followed by a weaker south-west monsoon than usual, more especially in the Arabian Sea branch of the monsoon currents. The rains are in such years late in their establishment over Western and Northern India, and the Bombay current retreats earlier than usual and gives considerably less rain than the normal over the whole area dependent on it. In such years Abyssinia usually suffers equally with Western India, as it is now fully established that years of drought in Western or North-western India are almost invariably years of low Nile flood. The relation is further confirmed by the fact that years of heavier rain than usual in Western India are also years of high Nile flood. It is also found, as might be anticipated, that the precipitation in these areas due to the humid south-west monsoon currents is not invariably distributed in the same proportion. Local conditions in one area may be more favourable than usual and its share is hence increased. There are no data available for Abyssinia, and the variations in the height of the Nile floods are not sufficient evidence, as they are probably due in part only to the Abyssinian rainfall. There is, however, marked opposition between the rainfall in Burma (and to a less extent in Bengal and Assam) and the rainfall in North-western and Western India.

south-east trades of the Indian Ocean.

Rainfall in Western India and Abyssinia appears to vary similarly, while rainfall in North-western India and Burma varies inversely.

The table on the next page, giving the annual variation of the rainfall in different areas from 1878 to 1902 as compared with the strength of the Nile flood, illustrates the preceding remarks.

India shows, moreover, large local variations from the normal distribution of the rainfall. When such is the case, it is found that the current and rainfall are determined largely by the abnormal pressure conditions set up during the hot weather and hence antecedent to the arrival of the rains. The currents are directed more largely than usual towards any area over which

Variations in local extension of monsoon currents caused by pressure anomalies.

there has been for some time previously a local deficiency, and less largely to areas in which there is from any cause a local excess, of pressure. These conditions cause a variation of rainfall from the normal in the earlier stages of the monsoon, viz. relative excess in one area and relative defect in another. This special rainfall distribution tends to maintain the pressure and other conditions which determined the initial set of the currents and consequent rainfall, and hence the areas of increased rainfall continue to be areas also of deficient pressure. Such

Year.	Nile Floods.	Rainfall Variation.		
		Whole of India (excluding Burma).	Burma.	North-western India.
		Inches	Inches	Inches
1878	Very high	+6·34	−27·32	+6·67
1879	Above normal	+1·69	+0·54	−1·04
1880	Below	−1·56	+3·78	−3·49
1881	Normal	+0·10	+5·45	+2·87
1882	Normal	+2·64	+11·00	+2·55
1883	Normal	−0·12	+1·43	−3·18
1884	Below	+1·73	−3·39	+6·01
1885	Normal	+1·05	+4·72	−1·22
1886	Normal	−3·02	−2·22	+0·33
1887	High	−2·42	+5·55	+1·48
1888	Below	−1·54	+11·51	−3·84
1889	Above	+2·41	−5·84	+0·37
1890	Above	+0·68	−6·23	−1·24
1891	Below	−3·54	+2·48	−2·32
1892	Above	+5·09	−7·28	+6·88
1893	High	+9·07	+7·04	+7·53
1894	High	+6·47	+11·47	+8·84
1895	Normal	−2·19	−11·63	−5·20
1896	Below	−4·83	+3·79	−2·87
1897	Normal (1897–1898)	−0·15	−0·13	−2·03
1898		+0·43	+0·40	−2·88
1899	Much below	−11·14	+6·33	−15·56
1900	Above	−0·57	−0·91	−1·08
1901	Above	−4·13	+0·07	−8·18
1902	Below	−2·05	−7·21	−5·17

persistency of abnormal pressure conditions is one of the most striking features of the meteorology of India, and it is mainly for this reason that the study of pressure anomalies in India must be the basis for any successful system of long period or seasonal forecasts from meteorological data. The continuity of pressure anomalies is sometimes persistent throughout the whole monsoon period, but occasionally interfering actions occur, such as snowfall in June or July in the Western Himālayas.

One of the more potent influences in modifying the pressure conditions antecedent to the advent of the monsoon is late and prolonged snowfall in the Himālayan regions. Mr. Blanford first fully investigated the question of the strength of the monsoon and distribution of the monsoon rainfall so far as it was modified by Himālayan snowfall, and upon an incorrect idea of his conclusions has been based what newspapers term the snowfall theory of the variations of the monsoon rainfall. According to this theory, snowfall is either the predominant or the only important factor, scanty snowfall preceding a strong, and excessive and prolonged snowfall a more or less deficient, monsoon. This snowfall theory is, however, *not* a theory of the Meteorological Department. All that Mr. Blanford established was that, in certain cases which he investigated, heavy and late snowfall in the Western Himālayas was followed by a late and scanty monsoon, more especially on the Bombay side, and that the relation held so closely in these cases that it might be used as an empirical guide for forecasting droughts. The relation was employed successfully in the last period of excessive and prolonged snow in the Himālayas to forecast drought in Central Rājputāna and adjacent districts in 1891.

Influence of snowfall in Himālayas on the rainfall.

The preceding remarks show that the distribution of the monsoon rainfall in India is not a simple but a very complex problem. It depends upon a large number of factors, every one of which must be taken into consideration if a rational explanation of the variations from year to year is to be given; and in attempting to forecast future conditions not only must each large factor be taken into account, but proper weight or value must be given to each factor. It should also be remembered that rainfall is, as a meteorological factor or element, quite different from pressure, temperature, and air movement. It is a discontinuous element, the only discontinuous element of importance at the present stage of meteorological discussion. It is, however, found that the relative or local distribution of any one south-west monsoon rainfall is similar in character throughout the whole period in about four years out of five. The application of statistical methods based on this general fact or principle (which may be termed the persistence of weather or meteorological conditions) will, it is hoped, continue to give more and more exact and numerous relations, all of which will be of use for seasonal forecasting in India.

Peculiar character of rainfall as a discontinuous phenomenon.

Important variations of monsoon rains from normal.

The following are the most important variations of the period and distribution of the monsoon rains from the normal which may occur:—

(1) The commencement of the rains may be considerably delayed over the whole or a large part of India. This is, on the whole, most frequent in Northern Bombay and North-western India. In 1877 the commencement of the rains on the Konkan coast was a fortnight later than the normal, and in 1896 a week later. The delay was most marked in the year 1900, when it amounted to three weeks in the Konkan, Kāthiāwār, and the Central Provinces, and to nearly a month in Central India and Rājputāna.

(2) There may be a prolonged break lasting over the greater part, or the whole, of either July or August (most usually August). Thus, in 1880 there was a break from August 14 to September 3 over the whole of North-western and Western India. In 1883 there was a break lasting nearly six weeks, from July 19 to the fourth week of August, in North-western and Central India.

(3) The rains may terminate considerably earlier than usual. The economic effect of this is occasionally very serious. The absence of rain may cause the chief crops, e.g. rice, to dry up, with the result that the harvest may fail either partially or completely. In 1874 the rains ceased in Bihār early in September. In 1883 they terminated about a month before their normal date over the greater part of Bengal. Similarly in 1896 they ceased four weeks earlier than usual in North-eastern India and six weeks before their normal date in the Central Provinces. In 1899 they terminated four weeks, and in 1902 more than a fortnight, earlier than usual in the Central Provinces.

(4) The rains may, as above observed, be directed more largely than usual throughout the whole or great part of the monsoon period to a given area and less than usual to another. This is the most common variation, examples occurring every year. For example, Assam, Eastern Bengal, and Burma almost invariably have heavier rain than usual when the fall is very deficient in the east of the Punjab and the Gangetic plain.

The following chart shows clearly the normal distribution of the rainfall of the period :— **Distribution of rainfall.**

CHART SHOWING THE NORMAL RAINFALL IN INCHES IN THE PLAINS OF INDIA, i.e. AT STATIONS BELOW 3,000 FEET IN ELEVATION, DURING THE PERIOD JUNE TO SEPTEMBER

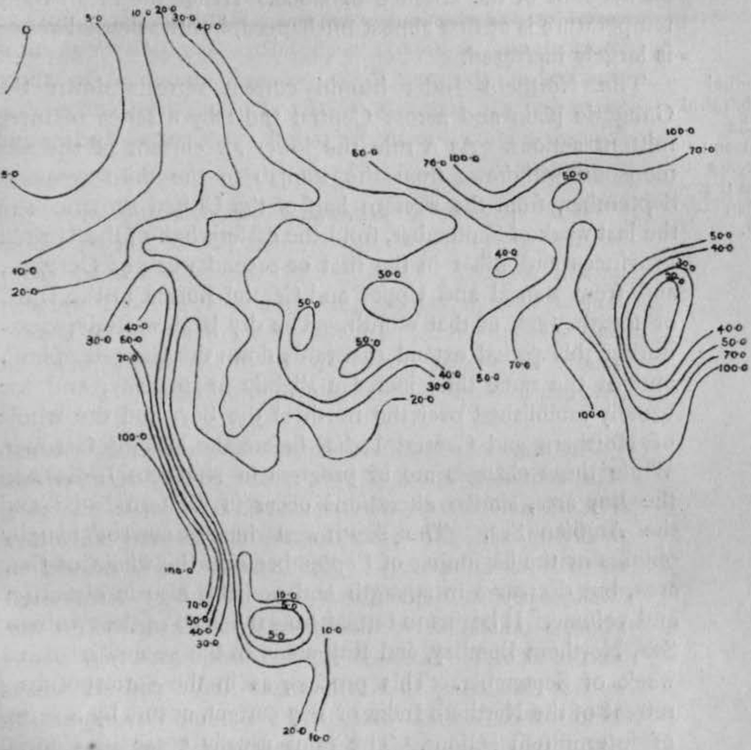


FIG. 4.

The second half of the wet season forms a transition period leading up to the establishment of the conditions of the dry season. During this period the area of rainfall contracts and extends southwards and diminishes in intensity, but is determined by the same winds or air currents, and by the same general conditions, as in the preceding period, June to September. The transition from the wet to the dry season commences in the latter part of September and is usually not completed until the third week of December. It is first **The retreating south-west monsoon period.**

exhibited in Northern India, and frequently follows upon a final burst of rain and thunderstorms accompanying the march of a cyclonic storm from the head of the Bay. The skies clear with the dispersion of the storm, and light and dry westerly airs replace the damp winds which previously prevailed. The night temperature decreases considerably with the increased dryness of the air, and the day temperature increases slightly on account of the absence of cloud. Hence the mean daily temperature is at first almost unchanged, but the diurnal range is largely increased.

Gradual withdrawal of the monsoon currents from the Indian area.

The Northern India humid current retreats down the Gangetic plain and across Central India by a series of intermittent actions. As a rule the lower air current of the wet monsoon withdraws from the Punjab in the third week of September, from the western half of the United Provinces in the last week of September, from the eastern half of the United Provinces and Bihār in the first or second week of October, and from Bengal and Upper and Central Burma in the third or fourth week of that month. The dry land westerly winds during this period extend eastwards down the Gangetic plain, and at the same time increase slightly in intensity, and are usually established over the north of the Bay, and the whole of Northern and Central India, before the end of October. While these changes are in progress in Northern India and the Bay area, similar alterations occur in Western India and the Arabian Sea. The south-west humid current usually obtains at the beginning of September over the whole of that area, but decreases in strength and probably also in elevation and volume. It begins to retreat from the head of the Arabian Sea, Northern Bombay, and Rājputāna in the second or third week of September. This process, as in the corresponding retreat of the Northern India or Bay current, occurs by a series of intermittent actions. The rains usually cease in Central India at the end of September, and in Berār and the Central Provinces in the second or third week of October. The further retreat of the currents in both sea areas is marked by novel features, more especially in the case of the Bay of Bengal. These features are most easily explained by reference to the pressure changes.

Pressure changes in Indian area.

During the south-west monsoon proper pressure is lowest in a belt across the Persian Gulf, the north of the Arabian Sea, Baluchistān, Sind, Eastern Rājputāna, and the southern districts of the United Provinces. As the air temperature diminishes, at first slowly and then rapidly, until the beginning or middle

of December, the air contracts over the cooling area and there is also a flux in the higher regions from the areas to the south, i.e. the Indian Ocean. This double action causes a continuous increase of pressure over the Indian land area, largest in amount where temperature decreases most rapidly and pressure was previously lowest, i.e. in North-western India. The low-pressure conditions previously prevailing in India are thus almost obliterated by October, when pressure is remarkably uniform. The only important feature during the remainder of the period is a residual shallow depression stretching eastwards and westwards across the Bay and Arabian Sea, with slightly higher pressure in the Deccan and South Indian areas. This depression is slowly transferred southwards during the period, and lies over the centre of the Bay at the beginning of November and over the south of the Bay at the beginning of December. The humid current of the retreating south-west monsoon continues over the area to the south of the belt and varies very largely in strength. When it is vigorous, it recurves round the eastern portion of the low-pressure belt and extends westwards in the area immediately to the north of it. At the same time, and as part of the general actions, a cyclonic storm forms and passes westwards, carrying the humid currents of the retreating monsoon with it and giving heavy rain. In the intervals between these actions the westerly winds in the south of the Bay are light in force. Light variable winds with fine weather prevail in the centre of the Bay, and light to moderate north-easterly winds in the north and north-west of the Bay. Periods of fine dry weather thus alternate with periods of showery and disturbed weather in the east coast districts of the Peninsula.

Recurvature of the Bay current in October and November towards the west. Rains in Madras.

The monsoon current recurves at the head of the Bay and in Bengal, in the same general manner (i.e. through north and north-west to west) as during the south-west monsoon proper. The recurvature is now, however, due not to the obstructive action of mountain ranges, but to special pressure conditions in the Bay. The retreating south-west monsoon gives occasional or frequent general rain during this period to the Madras coast. In October and the first half of November the precipitation occurs chiefly in the North Coromandel and Circārs districts, and in the second half of November and December chiefly or solely in the South Coromandel districts. In the second or third week of December the belt of low pressure usually passes out of the Bay limits into the equatorial belt, where it forms a permanent feature of the meteorology of the Indian

Ocean during the next five months. The heaviest and most general rainfall during this period accompanies the passage of the cyclonic storms of the period, which almost invariably advance westwards or north-westwards to the Madras coast. The Bay islands and the Malayan peninsula receive occasional rain during this period, but to a less extent than the Coromandel coast.

Probable conditions of retreat of monsoon current in the Arabian Sea.

Similar conditions probably obtain in the Arabian Sea. The humid current retreats slowly over the southern half of that area in October and November, and is in slight part directed to the Malabar coast, to which it gives occasional rain. It is probable that a belt of slightly lower pressure than elsewhere demarcates the northern extension of the current, which recurves to west and determines more or less general rain from lat. 16° N. southwards to the eastern coast of Africa, and also in the Equatorial Lakes region, the area of rainfall passing slowly southwards with the advance of the season. Cyclonic storms occur much less frequently in the Arabian Sea than in the Bay of Bengal during this period. They rarely form in that sea, but advance into it from the Peninsula and Bay area.

Storms of the period.

The humid current in the Bay continues to exhibit the same intermittent or pulsatory character as in the wet season. Periods of rain and strong winds alternate with periods of dry weather and light winds. Each period of general and heavy rain is as a rule initiated by the advance from the Bay of a cyclonic storm, which gives concentrated rainfall over long narrowish belts of country. These bursts of rain occur at longer intervals than in July and August, owing to the decreasing intensity of the humid monsoon current. It is, however, interesting, as an example of the opposition which frequently characterizes meteorological actions, that the antecedent conditions of uniform pressure and temperature and light variable winds during the intervals of fine weather between the rain periods favour the slow incubation of storms in the centre of the Bay, with the result that they are occasionally very intense and violent in character. The conditions are, on the whole, favourable for the formation of the most severe cyclones in October, when the humid currents that provide the motive power are still of moderate strength. These October cyclones are examples of the most intense tropical storms. They differ in several respects from the cyclonic storms of temperate regions. They are usually of small extent, occasionally not exceeding 200 miles in diameter.

Hence the shifts of wind accompanying them are very rapid and dangerous to vessels, and October is the most critical period of navigation in the Bay of Bengal. The pressure gradients are very steep and the winds of hurricane intensity in the inner storm area. The precipitation is excessive, the rain being commonly described as 'falling in torrents.' The most characteristic feature in the worst storms is an inner central area of calms or light variable winds, occasionally 10 to 20 or even 30 miles in diameter, which is termed by sailors 'the eye of the storm.' The transition from the calm area to the belt of hurricane winds is usually exceedingly rapid. Another characteristic feature of these cyclones is the piling up of a mass of water in the inner storm area and area of lowest pressure. This advances with the storm and strikes the coast as a 'storm-wave.' The effect of this in flooding the coast districts depends largely upon the phase of the ordinary tidal wave at the time when the storm-wave strikes the coast. If the storm-wave strikes the coast about high water or shortly after it may produce the most disastrous results, flooding low coast districts in a few minutes to the depth of ten, twenty, or even thirty feet above tidal high-water level. In such an inundation, caused by a storm-wave which spread up the Hooghly in 1737, 300,000 people are said to have perished, but the number is probably exaggerated. The storm-wave accompanying the Calcutta cyclone of October, 1864, drowned 50,000 people and caused immense destruction of shipping. That accompanying the Backergunge cyclone of 1876 was one of the most disastrous on record: probably over 100,000 people were drowned in less than half an hour in the islands and low districts at the mouth of the river Meghnā, while an equal number died from epidemics of fever, cholera, and other diseases which almost invariably follow a storm-wave. The total height of the wave was in some districts as much as 30 to 40 feet. Cyclones of the most dangerous type are fortunately rare, not more than one, on the average, occurring in five years.

Further pressure and temperature changes in India during period.

A moderate to rapid increase of pressure in October following the last burst of rain initiates cold-weather conditions, with fine dry weather, almost continuous cloudless skies, and light variable winds in Upper India, the monsoon current being, during the first fortnight or three weeks of that month, determined chiefly to North-eastern India and Burma, which areas usually receive moderate to heavy rain. The cessation of the rainfall in that area is followed by a rapid local rise of

pressure in Upper and Central Burma, Assam, and Bengal, and a general decrease of temperature and increase of pressure continue during the next two months. These changes are greatest in Upper India, and are small in amount in the extreme south of the Bay and in Southern India. Gradients for northerly winds increase more or less steadily throughout the period in the Indian area and the air movement increases in intensity. North-westerly and westerly winds obtain in the Gangetic plain, are continued as north-easterly winds in the north of the Bay, and extend southwards over the centre and south of the Bay as the season advances. A narrow belt intervenes in which winds are irregular and unsteady, ranging between south and east, while further south-south-west humid winds continue but decrease in general strength and volume.

This season really a transitional period of considerable duration.

The most important feature of the air movement of the whole period is thus the slow and gradual withdrawal of the south-west humid winds from the Indian area, and the gradual extension of the winds of the dry season from Upper India eastwards and southwards over the whole land and sea area. This change is usually completed before the end of December, when true north-east monsoon winds are established over the whole Indian region. The season above discussed is thus a transitional period of considerable length, and is in this respect unlike the transitional period at the commencement of the south-west monsoon. That monsoon is usually established rapidly over the Indian area, and extends over the greater part of the whole of the interior in the course of a week or a fortnight. The advancing current is a vigorous movement, while the retreating current, and the current which gradually displaces it, are both feeble.

Precipitation of period.

The rainfall due to the decaying and retreating current is not only much smaller in amount than during the previous three months, but also much more irregular. The whole area of North-western and Central India and Northern Bombay receives practically no rain during this period. The Punjab and the adjacent districts receive a small amount, chiefly due to one or more cold-weather storms in the last fortnight of December. North-eastern India and Upper Burma obtain light to moderate rain, chiefly in October, and Lower Burma moderate to heavy rain in October and the first half of November. On the other hand the Madras coast districts receive their chief rain supply during this period. The amount increases southwards from Ganjām to Negapatam, but decreases very rapidly in amount from the coast to the interior.

The important variations to which the weather is subject in this period are as follows:—

A. The number and character of the storms which form in the Bay, and hence also the distribution of the rainfall accompanying the retreat of the south-west monsoon humid current, vary very largely from year to year. In some years, as for example in 1896, no storm of importance occurs, while in others two to four severe storms or cyclones may be experienced. The years 1876, 1886, and 1891 were remarkable for the number of fierce and extensive cyclones which occurred during this period.

More important abnormal features of weather and rainfall distribution of period.

B. The character of the large general and local pressure changes which accompany the gradual withdrawal of the monsoon current in India, and which appear in part to determine and in part to be determined by rainfall, varies largely from year to year. Thus an abnormally large increase of pressure in October over North-western and Central India is almost invariably accompanied by absence of rain in the Deccan. Similarly, a delay in the establishment of the high-pressure conditions in North-eastern India and Burma accompanies, and in part at least determines, a prolongation of rainfall in that area to the exclusion of the Peninsula. The late rains are then not only delayed in that area, but are scanty and more irregular than usual.

The most important variations from the normal of the rainfall distribution of this period may be summarized as follows:—

(1) Prolonged rainfall in Burma, Tenasserim, and the Bay islands, and consequent deficient rainfall in Madras and the Deccan.

(2) Early termination of the rains in Burma, accompanying increased rainfall in the Peninsula.

(3) Deficient and scanty rainfall in the Deccan and Northern Madras, accompanying normal or increased rain in Southern India.

(4) Early termination of the rains in both the Burma and Madras areas, due to more general actions and conditions than the local conditions in the Indian area; these have not yet been fully investigated.

(5) Early commencement of the cold-weather rains in Northern India, almost invariably preceding prolonged stormy weather with much snow in the northern mountain ranges.

II. Special Remarks on Rainfall in India, and Droughts

Aqueous vapour.

The air is always more or less charged with aqueous vapour. The amount is measured (in English measures) absolutely by the weight in grains per cubic foot, and varies greatly with the season and with the elevation and position. In the Bombay and Bengal coast districts, during the height of the wet monsoon, it is about 10 to 12 grains per cubic foot; whereas in the interior of India during the driest periods it is not more than four grains per cubic foot, and occasionally even less. 'Relative humidity' is humidity in relation to temperature, and indicates how far the air departs from saturation with respect to aqueous vapour.

Rate of cooling of ascending air.

Unsaturated air can always be cooled down until the space is saturated and further cooling gives rise to condensation. There are many complex problems connected with the processes of condensation and rainfall, but the main actions are simple. Ascending air always cools down at a rate depending upon the amount of aqueous vapour it contains and whether condensation is in progress. If the air be not saturated, it cools down at a rate of about 1° F. per 200 feet; but as soon as it reaches the saturation stage, followed by rain, condensation commences and continues so long as rapid ascensional movement continues. The heat given out in this process acts mechanically on the atmosphere and tends to increase the ascensional movement. The rising air cools down, but at a much slower rate than previous to condensation. In this stage the rate of cooling may be as low as 1° F. per 500 feet. Uptake or ascensional movement is thus a very powerful means of producing the cooling necessary to condensation and rainfall.

Ascensional or convective air movement the chief cause of rainfall.

There are other processes, as for example the mixture of cool and warm masses of air, but they are probably of comparatively rare occurrence and seldom give rise to heavy general rain. Hence it may be assumed that rainfall in a humid current is chiefly, if not almost entirely, due to upward movement, which may be initiated by various actions. Whatever the initial cause, the continuance of the movement is in large part strengthened and maintained by the energy set free by the condensation of the aqueous vapour, and converted by physical processes into the energy of motion of the atmosphere affected.

Ascensional movement largely

The initial ascensional movement may, in part at least, be due to the ordinary diurnal changes in progress caused by the heating of the land surface during the day. When the

ascensional movement is very large, as in the hot weather, it is possible to get this action even although the column of ascending air may be very dry near the earth's surface. This is shown by the occasional occurrence of showers of rain or hail in the hottest and driest districts. There is hence a marked tendency, especially in the hot-weather period, to the occurrence of rain at the same time of the day.

due to diurnal heating by solar action.

The uptake or ascensional movement may also be due to the forced ascent of a humid current against and across a range of hills, initiated by the momentum of the moving mass in the rear and further accentuated by the rainfall to which it gives rise. Rainfall is therefore usually heavy on and near any range of hills facing a humid current, but diminishes very rapidly on passing beyond the crest of the hill range, when the current not only ceases to rise but may descend slightly, and has, during the process of rising over the mountain ridge, been deprived of a considerable portion of its moisture. There is in such cases a very marked contrast between the rainfall on the two sides of hill ranges across which humid currents pass and the adjacent plain districts.

Ascensional movement of humid current forced up and across a line of hills.

Ascensional motion also occurs on a large scale in cyclonic storms, and hence heavy rainfall is the most prominent feature of these storms in India. The rainfall is usually greatest in the advancing quadrant of these storms. The heaviest downpours frequently occur in the interior of India and not in the coast districts, and more especially in the neighbourhood of the hills athwart the track of a storm. Falls ranging between 20 and 35 inches in twenty-four hours occasionally occur under these conditions. Such was the heaviest fall on record in the plains of India: namely, 35·38 inches at Purnea, in Bihār, on September 13, 1879.

Ascensional movement in cyclonic storms.

The rainfall of the ascensional motion may, lastly, be due to the increased resistance to the horizontal movement experienced by a humid current crossing a coast and advancing landwards, as, for example, across Bengal and up the Gangetic plain. This is undoubtedly one action determining a considerable portion of the monsoon rainfall.

Ascensional movement due to resistance to horizontal movement at the earth's surface.

The above are the chief actions producing rainfall in the humid south-west current. Other minor actions might be enumerated; but it is sufficient to refer to Mr. Blanford's monograph on *The Rainfall of India* for a full statement and a fairly complete explanation of the causes co-operating to determine the rainfall in each district of India, and also to some extent the variations from year to year.

Distribution of rainfall by season in India.

A brief account of the character and distribution of the rainfall of each of the seasons has been given under the meteorology of that season. The following gives a statement of the mean or normal rainfall in India, derived from the average data of about 2,000 stations distributed somewhat unequally over the whole of the country:—

Cold weather (January–February)	0·99 inches.
Hot weather (March–May)	4·58 ,,
South-west monsoon (June–September)	34·65 ,,
Retreating south-west monsoon (October–December)	4·95 ,,

Of the mean annual rainfall 12 per cent. occurs during the dry, and as much as 88 per cent. during the wet, season. The ratios differ very considerably in different parts of India, varying for the dry season from 3 per cent. in Bombay to 19 per cent. in Bengal, 21 per cent. in the Punjab, and 30 per cent. in Assam. These figures show the importance of the hot-weather or spring rainfall in Assam, and of the cold-weather rainfall in the Punjab. Appendix A (p. 153) gives data for the meteorological divisions lately adopted in the India Daily Weather Report.

Cold-weather rainfall.

The cold-weather rainfall is due almost entirely to disturbance and condensation in an upper current, probably over 15,000 feet in elevation. Hence its distribution is very slightly modified by the configuration of the country over which the current passes, except over and near the only mountain range sufficiently elevated to give rise to forced ascent on the large scale, viz. the Himālayas. The precipitation is large over the interior elevated ranges, and moderate over the outer ranges, of the Western Himālayas. It diminishes slightly from the submontane districts southwards, and from the Punjab eastwards to Bihār, but thence increases again to Assam. It is very irregular in its occurrence, but the normal amount differs very slightly over the plains of Northern and Central India, varying from half an inch to one inch, except in the Punjab and Assam, where it averages two inches.

Due to storms.

As already pointed out, the precipitation of the cold-weather period occurs during the passage of shallow extensive depressions across Northern India from west to east. These storms are almost the only source of rain in Persia, Afghānistān, and Baluchistān, and to a less extent on the higher and interior ranges of the Western Himālayas. The cold-weather rainfall is small in absolute amount in Northern and Central India, but is nevertheless of great economic importance over the larger

part of that area, as it is upon this rainfall that the wheat and other cold-weather crops of the non-irrigated districts in Northern India depend. In the districts to which irrigation extends the crops are practically independent of the rainfall; but over the unirrigated districts, including the greater part of Rājputāna, Sind, Central India, and parts of the Punjab and the United Provinces, such cultivation as there is largely depends upon the amount and time distribution of this limited rainfall.

Hot-weather rainfall. The distribution of the hot-weather rainfall presents much greater contrasts than that of the cold weather. It is due, as previously stated, to large convective movements over the interior plains raising air masses to a sufficient height to produce condensation, and to forced ascent of local sea winds across hill ranges in Assam, Bengal, Orissa, and Malabar, supplemented more or less largely by convective air movements due to the intense thermal actions of the period. The rainfall often accompanies dust-storms in the interior, and is small in amount, averaging only about an inch, over Bombay, Berār, the Central Provinces, Central India, Rājputāna, and the Gangetic plain. It accompanies thunderstorms (occasionally of extraordinary violence and intensity) in Assam, the greater part of Bengal, Arakan, and Lower and Upper Burma, and is largest in amount in Assam, where it averages 31 inches. Economically it is of great importance for the tea crop of Assam, and in Bengal, where it favours an early spring crop of rice. Over the greater part of the interior it is of little agricultural value, and the violent winds and heavy rain accompanying the storms occasionally do great damage.

Rainfall of the wet or south-west monsoon. It is upon the south-west monsoon rainfall that the prosperity of India chiefly depends. As already stated, nearly 90 per cent. of the whole rainfall of the year falls on the average during this part of the year, being due to the invasion of India by oceanic currents of great volume and elevation from the Arabian Sea and the Bay of Bengal. The goal of these currents from June to September in India is a persistent low-pressure area in Upper Sind and the neighbouring districts of Rājputāna and the Punjab. The transformation effected by the invasion of these currents is comparatively slight in the regions of frequent thunderstorms in April and May: that is, in Lower Burma, Bengal, Assam, Orissa, and the Madras coast. Over the remainder of India, and more especially in the interior of the Peninsula and in Northern and Central India, it is very pronounced. Previous to its advance

strong land winds, almost unbearably high temperature, excessive dryness of the air, and a dust-laden atmosphere are the chief features. Afterwards strong to moderate sea winds, moderate temperature, great humidity, much cloud, frequent rain, and a comparatively clear atmosphere are prevalent. From June to September the two currents give rain chiefly to Burma, Northern and Central India, and the northern half of the Peninsula, while over the southern half of the Peninsula rain occurs very irregularly (chiefly during breaks of the rains in Northern India) and is scanty except on the Malabar coast. The distribution of the rainfall during this period (June to September) is determined chiefly by ascensional movement due to (1) forced ascent across hills, (2) convective ascent in cyclonic storms, and (3) irregular ascensional movement caused by resistance to horizontal air movement, or due to actions accompanying the heating of the atmosphere during the day hours over the drier parts of the interior.

Action of forced ascent of aqueous vapour.

The action of forced ascent across or against hill ranges gives heavy rain in (*a*) the west coast districts of Malabar, the Konkan, and Gujarāt, (*b*) Tenasserim and Arakan, (*c*) the Assam hills and Sylhet, and (*d*) the Lower Himālayas and submontane districts, more especially the eastern half. Actual data show that in the Western Ghāts the rainfall is on the average at least three times as great on the crest of the hills as at sea-level. The average rainfall of the period is roughly 100 inches in the coast districts of the Konkan, and thence increases up to an average of 300 inches at stations situated on the crest of the hills facing the sea at an elevation of 3,000 to 4,000 feet. A similar law of distribution almost certainly holds in the case of the Tenasserim, Arakan, and Assam hills. Sylhet at the foot of the Assam hills has an average total of 157 inches, while Cherrapunji in the Assam hills, at an elevation of about 4,000 feet, has an average of 458 inches. The inverse action to that of forced ascent is found in the districts on the landward side of ranges of hills which face the monsoon currents. The current, which has been deprived during ascent of a large portion of its aqueous vapour, after it passes over such a range, either moves horizontally or descends slightly, and is then, unless some other special actions come in, virtually a non-rain-giving current. Hence the Bombay and Madras Deccan Districts of Sholāpur, Bijāpur, Ahmadnagar, Poona, and Bellary are very dry areas and specially liable to drought. Similarly, a portion of Central and Upper Burma, including the Districts of Magwe, Minbu, Myingyan, Kyaukse, and Sagaing, is a very

dry and precarious area, with a scanty rainfall averaging not more than 30 inches for the year. The Himālayas are not exposed to the full burst of the annual monsoon currents. The Bay current advances towards them, but is deflected, and though there is much ascensional movement, it is not forced ascent accompanying movement across the line of hills. Hence the distribution of the rainfall does not follow exactly the same law as in the Western Ghāts or the Assam hills. The rainfall is, however, considerable over the Lower Himālayan ranges up to levels of 8,000 to 10,000 feet, but is slight on the higher elevations or in the interior valleys. The rainfall again decreases considerably southwards in the submontane districts, and over the Gangetic plain it is determined partly by ordinary ascensional movement and partly by cyclonic storms.

Of cyclonic storms.

A considerable proportion of the wet monsoon rainfall over the greater part of India is due to the ascensional movement accompanying cyclonic storms. On the average eight storms of moderate to considerable intensity pass from the Bay of Bengal into India between June and September. They travel comparatively slowly and frequently traverse the whole breadth of Northern India. Their characteristics, and the accompanying rainfall, have already been noticed on page 125.

After the Bay current has withdrawn from Northern India and Upper Burma, and is recurving over the Bay, it is, as already stated, directed to the Peninsula. It is now, however, comparatively feeble, and probably its elevation as well as its volume diminishes and it becomes less effective as a rain-giving current. Cyclonic storms occur at longer intervals, but continue to give large amounts of rain to the areas they pass over. Their path is, usually in the latter part of October and almost invariably in November and December, westward to the Circārs and Coromandel coasts. The rainfall in the Deccan and Southern Madras coast districts during this period occurs almost entirely in connexion with these storms, and is hence extremely irregular in its distribution. The rainfall is heaviest in a narrow belt of the Coromandel coast, where it ranges between 20 and 30 inches, and decreases rapidly on proceeding into the interior. It is occasionally very heavy in the Nīlgiris, when the storms advance into the interior of Southern India and break up against the high hill ranges.

Examples of excessive downpours in twenty-

A characteristic feature of Indian meteorology is the excessive downpours which occasionally occur, chiefly during the passage of the cyclonic storms of the south-west monsoon, and also

four hours during the wet monsoon. in the Western Ghāts and Lower Himālayas during a strong influx of monsoon winds. The fall at Purnea in Bihār of 35·38 inches in one day, in September, 1879, has already been mentioned (p. 139). Other phenomenal downpours, exceeding in each case 24 inches within the twenty-four hours, have been:—

Year.	Date and month.	District.	Station.	Amount of rainfall in 24 hours.
1876	June 14 .	Khāsi and Jaintiā Hills .	Cherrapunji .	40·80
1880	Sept. 18 .	Bijnor	Nagīna . .	32·40
1880	Sept. 18 .	Bijnor	Dhāmpur .	30·40
1888	May 27 .	Khāsi and Jaintiā Hills .	Jowai . .	30·20
1890	June 13 .	Khāsi and Jaintiā Hills .	Cherrapunji .	30·04
1885	June 15 .	Khāsi and Jaintiā Hills .	Jowai . .	29·20
1880	Sept. 18 .	Bijnor	Najībābād .	28·50
1893	May 30 .	Cāchār	Nemotha .	27·30
1890	June 29 .	Rangpur . . .	Bhawāniganj .	27·00
1891	July 28 .	Surat	Jalālpur . .	25·85
1888	June 27 .	Khāsi and Jaintiā Hills .	Mahādeo .	25·80
1886	June 18 .	Colāba	Roha . .	24·80

Another noticeable feature is the very heavy downpours which occur in very short periods, chiefly accompanying thunderstorms. The most striking examples have occurred at Calcutta and Nāgpur, at each of which places slightly over an inch has fallen within ten minutes, equivalent to a rate of nearly seven inches per hour.

Variability of rainfall. A most important feature in determining the economical value of rainfall in any given district is its variability. This can be estimated in various ways. Mr. Blanford, in his monograph on *The Rainfall of India*, has investigated the variability in the twenty-two rainfall divisions which he adopted for the seasonal returns submitted regularly to the Secretary of State for India by the Meteorological Department. According to this method (based on the law of errors and method of least squares) the variation from the normal rainfall for which the probability is $\frac{1}{2}$ (i.e. the chances are 1 to 1) is determined, and then expressed as a percentage of the normal rainfall. Some of the results of Mr. Blanford's calculations will be given on the opposite page. This is undoubtedly the most scientific method of determining estimates showing the probable range of variation of rainfall. It is, however, too elaborate for general use over a very large area like India. The simplest method is to adopt as the measure of variability the

percentage ratio of the difference between the highest and lowest actuals for the period of observation to the normal or average rainfall of the period. The largest percentages of variability as thus calculated are those of the areas named below :—

Meteorological Division.	Percentage variability of annual rainfall.	Annual rainfall in inches.
Gujarāt	161	27·64
North-western Dry Area .	150	10·24
Baluchistān	133	8.66
Indo-Gangetic Plain, West	100	30·89
Deccan	93	29·68
East Coast, south . .	90	51·59

The most noteworthy feature is the very great variability of the rainfall in Gujarāt. This is due to the fact that it is liable not only to very scanty rain in dry years, but to excessive downpours from cyclonic storms in years of ordinary or strong monsoon conditions.

The following table gives Blanford's estimates of variability for thirteen areas :—

Area.	Mean annual percentage deviation from the average rainfall. (Blanford's method.)
Sind and Cutch	± 37
United Provinces . . .	± 23
Khāndesh and Berār . .	± 20
Bihār	± 18
Hyderābād	± 17
Central India	± 15
Gujarāt	± 15
North Deccan	± 15
Mysore	± 15
Carnatic	± 13
Rājputāna	± 13
Punjab	
Orissa and Northern Circārs .	± 12

When the rainfall in any area is too scanty for the staple crops of that area, and a partial or complete failure of the harvest ensues, the season is one of drought which may, if severe and long continued, produce famine[1]. A large deficiency of rain in an area of heavy rainfall, as for example Arakan,

Deficient rainfall and droughts.

[1] Famine is the subject of a separate chapter (Vol. III, chap. x).

East Bengal, &c., rarely, if ever, affects the staple crops to an extent sufficient to justify the use of the term 'drought.' Droughts chiefly occur in the interior districts where the normal rainfall, when properly distributed, is sufficient for the crops, though not ample or abundant. The table on the preceding page gives a list of the larger areas liable to drought in the order of the variability of the rainfall as determined by Mr. Blanford (vide *The Rainfall of India*, p. 129).

Mr. Blanford, from examination of the data, inferred that droughts leading to famine were especially likely to occur in all districts in which the variability, as measured by the process described on p. 125 of his memoir, is twelve or upwards.

Scanty and ineffective rain in the wet monsoon in any area is due to one or more of the causes referred to on p. 130. The rainfall of the first half of that monsoon is much less valuable and effective, on the whole, for agricultural purposes than the rainfall of the second half. It is essential that there should be occasional to frequent rain in August and September, and occasional rain in October, in order to bring the chief food crops to perfection. An abrupt termination of the rains in August may cause the whole of the rice crop in a Province to fail to come to maturity.

In North-western and Central India not only may the rains of the south-west monsoon fail more or less completely, but also the preceding or following cold-weather rains, and failure of the first is, in about two cases out of three, accompanied by failure of the second. This double drought entails loss of the harvest of both seasons and is most disastrous. The most severe droughts in the Punjab and the Gangetic plain have been of this kind. Finally, a severe drought leading to famine may occur after a series of bad years, owing to excessive or deficient rain, either of which may diminish the crop returns for several years by large percentage amounts. This was the case in the Central Provinces in 1896.

III. Special Remarks on Indian Temperatures

Measurement of air temperature.

Temperature is perhaps next to rainfall the most important feature of meteorological observation in India from the economic standpoint. Temperature in relation to the amount of aqueous vapour present in the air and the rainfall determines the character and abundance of the staple crops. The temperature of the air in India is carefully measured

under, so far as is possible, approximately similar conditions. The thermometers are exposed in open sheds, through which the air freely circulates, and are protected from the direct influence of the sun by a thick roof or thatch of straw. The bulbs of the instruments are placed as nearly as possible at the same standard height above the ground, viz. four feet.

The sun is practically the only hot body which materially modifies and determines the temperature of the earth's atmosphere. The solar radiation is absorbed in part during its passage through the earth's atmosphere and in part by the earth's surface, which again gives up a portion of its heat to the adjacent air.

Variation of ground surface temperature and effect on air movement.

The average temperature of the ground surface in India is, at the hottest time of the day in the cold weather, from 10° to 20° above the temperature of the air four feet high. The difference increases until the months of April and May, when the excess is usually as much as 40° and sometimes 45° or 50°. The difference falls off rapidly during the rains, and in August is as small as in the height of the cold weather. At Jaipur the ground has been found to be cooler than the adjacent air four feet above for sixteen hours out of the twenty-four in December and for twelve hours in May.

The air in contact with the earth's surface is largely and rapidly heated during the day time, and is then carried upwards by virtue of the convective movements thus initiated. These movements tend to distribute the heat taken in by the air at the earth's surface throughout the superjacent mass, and give rise to changes of temperature of great importance.

Variation of air temperature.

The temperature of the air at any fixed position or place is in a constant state of flux or change due to a variety of actions, more especially (*a*) the absorption of heat or solar energy either directly or indirectly, (*b*) the radiation of heat to the earth, clouds, or space, (*c*) the vertical or horizontal movement of the air in the lower strata. The most effective cause of rapid temperature changes is the displacement of air of one character by that of another, such as almost invariably occurs in the alternation of land and sea breezes, or accompanies hailstorms, thunderstorms, cold-weather cyclonic storms, &c. These changes are usually very irregular in character. The temperature of the air varies (1) regularly in consequence of the regular variations in the causes or actions modifying it, the most important of which is that of the sun's thermal action

as modified by elevation, and (2) irregularly owing to the actions enumerated above.

Diurnal variation of the air temperature.

The temperature of the air is increased by the absorption of solar radiation or radiant energy directly or indirectly during the day hours, while it is affected during the whole diurnal period by radiation to clouds, space, &c. The result of these two actions is that in the lower atmosphere the temperature of the air is lowest very shortly before sunrise, and increases until two or three hours after noon, after which it decreases until next morning before sunrise. This fairly regular variation, with a maximum and minimum, which divides the day into unequal periods of about eight hours and sixteen hours on the average of the year, is the diurnal variation.

Diurnal range.

The difference between the maximum and minimum temperatures of any twenty-four hours period, as for example the ordinary civil day, is the 'diurnal range.' The diurnal range depends chiefly upon the amount and distribution of cloud and also upon the humidity. The following summarizes the chief features of the diurnal range:—

(1) It is much smaller in the wet than in the dry season, the difference being most marked at stations in the interior.

(2) It is smallest in amount at the coast stations, more especially at those on the Konkan and Malabar coasts, where it averages 10°, and increases on proceeding into the interior to a maximum of 30° on the mean of the year in the Punjab and Upper Sind.

(3) It has, over the greater part of Northern and Central India, two maximum and minimum values. It is usually absolutely greatest in November, the most serene month of the year; falls slightly up to January or February; increases again up to April and May; and falls to the absolute minimum in July or August, the height of the rains.

Annual variation of the air temperature.

Again, during one part of the year, from January to May or June, the increase of temperature by the solar action is greater than the decrease or loss by radiation and other actions, and hence temperature rises more or less steadily during this period of increasing elevation of the sun. During the remainder of the year the balance is the other way and temperature steadily decreases from June or July to December. This regular increase during one half of the year, followed by decrease

during the other half, is known as the annual variation. The annual variation is estimated in various ways. The most usual methods are (*a*) as the difference between the highest and lowest monthly means, (*b*) as the difference between the highest and lowest daily means, (*c*) as the difference between the highest normal daily maximum and lowest normal daily minimum temperatures during the year, and (*d*) as the mean of the annual absolute range of temperature: that is, of the differences between the highest maximum and lowest minimum observed in each year. The data establish that the annual variation (calculated by any of these methods) is small in amount at the Bay islands and in Malabar. It increases rather rapidly northwards in proceeding along the east and west coasts of India. It is twice as great at Bombay and Rangoon as in Malabar, three times as great at Madras and Chittagong, and over five times as great at Karāchi. It is from eight to ten times as great at the stations in the North Deccan and Northern and Central India, and is absolutely greatest in the most inland and the driest districts, including Upper Sind and the Punjab.

Maximum diurnal temperatures.

The highest day temperatures are usually observed in Northern India in the month of May. The hottest area is undoubtedly that part of Upper Sind known as the Pat desert, of which Jacobābād is imperfectly representative, and after that, the adjacent tracts, including the South-western Punjab and North-western Rājputāna. In seventeen out of the last twenty years the highest day temperatures, ranging from 117° to 126°, were recorded at Jacobābād. As there is much irrigation in and near this town, which is more or less sheltered by trees, it is almost certain that at Sibi and other places in the driest parts of the Pat desert the maximum temperature probably reaches 130° in the hottest periods. Maximum temperatures exceeding 120° have been recorded at the stations named below:—

Jacobābād.	Jodhpur.
Pachbhadrā.	Sirsa.
Hyderābād.	Multān.
Montgomery.	Khushāb.
Dera Ismail Khān.	Lahore.
Agra.	

Minimum diurnal temperatures.

The conditions which determine the night temperature are very different from those on which the day temperature depends. Radiation into space and conduction to the ground surface are

the chief actions. The effect of these actions in reducing temperature is greatest in clear dry still nights, such as usually obtain in the cold and hot weather in North-western and Central India and the North Deccan. The air cools almost continuously during the night at rates depending upon the amount of cloud, the humidity of the air and other conditions; and the lowest temperature is, on the average of the year, observed at 5.30 a.m. or about half an hour before mean sunrise. The lowest minimum night temperatures are almost invariably recorded in Northern and Central India during the cool periods after the passage of cold-weather storms. The following gives the lowest temperatures (26° or below) that have been recorded at the chief meteorological stations in the plains of North-western India:—

	Station.	Lowest minimum temperature.	Date.
		°	
Punjab and Frontier Province	Peshāwar	25.7	December 19, 1878.
	Rāwalpindi	23.9	December 28, 1878.
	Khushāb	25.0	January 15, 1899.
	Dera Ismail Khān	26.0	January 9, 1876.
	Ludhiāna	24.0	December 6, 1879.
Rājputāna	Pachbhadrā	25.4	February 18, 1882.

Mean diurnal temperatures.

Mean daily temperature is usually defined by meteorologists as the mean of twenty-four readings of a standard thermometer, properly exposed, taken at hourly intervals. Hourly observations, however, are recorded at only three or four stations in India. Hence in the India Daily Weather Reports the mean temperature of any day is taken as the semi-sum of the maximum and minimum temperatures recorded during the day. This differs from the true mean as defined above by small amounts which have been approximately determined from short series of hourly observations in different parts of India.

Appendix B (p. 154) gives comparative data of this element for twenty-three representative stations in India and illustrates sufficiently the mean or normal temperature conditions over India.

Hill temperatures.

The temperature at hill stations is determined only very slightly by the direct action of the sun, and chiefly by the large convective air movements over the plains, and by the inter-

change or diurnal air movement between the plains and hills which is a permanent feature in Himālayan meteorology. Appendix C (p. 155) gives the average mean temperature of twelve representative hill stations for each month.

At stations in mountain valleys, e.g. Srīnagar and Leh, the maximum day temperature is determined chiefly by solar action and local conditions of cloud, &c. At stations on the crests of the outer mountain ranges it is, in dry clear weather, conditioned almost solely by the convective movement over the plains in which dry air, rising rapidly, cools down at the rate of 1° per 186 feet. During the rains, when there is much forced ascent of the humid current against and over the hills, it is conditioned by that movement, in which humid air at the mean temperature conditions cools down at rates which vary from about 200 to 500 feet per degree.

The night temperatures at hill stations are, more especially in fine dry clear weather, determined by actions and conditions very different from those which give rise to the day maximum. The air cools rapidly by radiation and conduction to the ground on the higher elevations, and sinks down into the valleys, where it tends to accumulate and give decreasing temperature as the night advances. On the mountain crests it is modified by the upper air currents which set in from the plains towards the higher ranges. These actions tend to give much lower night temperatures at the same elevation, and a larger diurnal range in valleys than on the mountain crests.

In fine dry weather, when there is little air movement, temperature falls rapidly at stations such as Murree, Simla, and Chakrāta on open mountain ridges from 2 p.m. to 6 p.m., and is then practically constant during the whole night from 7 p.m. to 5 a.m. Another important feature is that when the conditions obtaining in fine dry weather in Northern India are most marked—that is, when the temperature at night falls rapidly in the plains owing to radiation in a clear calm atmosphere until shortly before sunrise, and when it remains nearly constant on the crests throughout the whole night—the minimum temperature at hill stations may be considerably higher than at neighbouring stations in the plains 5,000 and 6,000 feet below. This frequently occurs in continuous anticyclonic periods during the cold-weather period when the cold-weather rains are late and scanty. One example will be sufficient to illustrate these remarkable temperature conditions. The minimum temperature at Murree on the night of January 2, 1889, was 12·4°

higher than at Rāwalpindi, and 8·2° higher than at Siālkot; at Simla it was 12·1° higher than at Ludhiāna, and 11·8° higher than at Lahore; and at Rānīkhet it was 13·4° higher than at Roorkee, 18·2° higher than at Bareilly, 6·4° higher than at Agra, and 7·3° higher than at Allahābād. This was on the whole the most remarkable example of the inversion of the temperature with elevation that has occurred during the past twenty years in the cool season in Northern India.

APPENDIX A

RAINFALL DATA OF 21 METEOROLOGICAL DIVISIONS OF INDIA (IN INCHES)

Province or Division.	Normal Rainfall.						
	Cold-weather period (January and February).	Hot-weather period (March to May).	South-west monsoon period (June to October).	Retreating south-west monsoon period (November and December).	Dry season (January to May).	Wet season (June to December).	Total of Year.
Burma, Coast	0·71	18·08	130·63	3·52	18·79	134·15	152·94
Burma, Wet	0·49	7·51	55·29	1·69	8·00	56·98	64·98
Burma, Dry	0·15	6·36	24·49	1·65	6·51	26·14	32·65
Delta of Bengal	1·64	15·58	60·78	1·38	17·22	62·16	79·38
Brahmaputra Valley	2·37	23·99	64·99	1·01	26·36	66·00	92·36
Indo-Gangetic Plain, East	1·31	3·72	41·85	0·58	5·03	42·43	47·46
Himālayas and Sub-Himālayas, East	1·27	6·35	56·51	0·33	7·62	56·84	64·46
Himālayas and Sub-Himālayas, West	3·89	2·92	34·85	1·18	6·81	36·03	42·84
Further Kashmīr	3·36	5·57	2·34	1·45	8·93	3·79	12·72
Indo-Gangetic Plain, West	1·52	1·20	27·58	0·59	2·72	28·17	30·89
North-West Dry Area	1·02	1·30	7·49	0·43	2·32	7·92	10·24
Baluchistān	3·78	2·52	0·94	1·42	6·30	2·36	8·66
West Coast	0·89	9·40	85·08	4·83	10·29	89·91	100·20
Gujarāt	0·12	0·22	26·96	0·34	0·34	27·30	27·64
South India	0·58	6·21	18·55	5·83	6·79	24·38	31·17
Deccan	0·16	2·36	25·35	1·81	2·52	27·16	29·68
West Sātpurās	0·56	1·00	31·74	1·02	1·56	32·76	34·32
Central India Plateau	0·75	0·87	30·02	0·61	1·62	30·63	32·25
East Sātpurās	1·14	2·91	50·76	0·86	4·05	51·62	55·67
East Coast, North	0·78	5·18	41·30	4·24	5·96	45·54	51·50
East Coast, South	2·29	3·06	22·91	23·33	5·35	46·24	51·59

APPENDIX B

AVERAGE MEAN TEMPERATURE (FAHRENHEIT) AT TWENTY-THREE REPRESENTATIVE STATIONS IN THE PLAINS

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Trivandrum	77·3°	78·7°	80·9°	81·9°	81·3°	78·3°	77·6°	77·7°	78·0°	77·8°	77·4°	77·4°	78·7°
Trichinopoly	77·3	80·4	85·4	89·3	90·3	88·7	87·7	86·7	85·6	82·7	79·6	77·3	84·3
Madras	76·1	77·5	81·1	85·1	89·8	89·6	87·2	85·6	85·0	82·1	78·7	76·5	82·9
Bangalore	68·5	72·7	77·7	81·2	80·2	75·8	73·9	73·7	73·6	73·3	70·6	68·4	74·2
Bombay	75·3	75·7	79·6	83·1	85·7	83·6	81·0	80·5	80·5	82·0	80·1	77·2	80·4
Nāgpur	69·6	74·7	83·1	90·9	95·6	88·4	81·5	80·8	81·6	79·3	72·7	67·8	80·5
Rangoon	76·7	79·4	83·9	87·4	84·6	81·5	80·6	80·4	80·8	81·7	80·0	77·3	81·2
Mandalay	70·1	75·0	82·8	90·1	89·0	86·8	86·3	85·5	84·9	83·3	77·0	70·8	81·8
Chittagong	66·8	70·7	77·2	81·3	82·0	81·6	81·2	80·8	81·6	80·0	74·4	68·1	77·2
Calcutta	66·2	71·2	80·2	85·7	86·0	84·8	83·3	82·7	82·9	80·5	73·0	66·3	78·5
Silchar	65·1	68·2	74·6	78·9	80·6	82·8	83·7	83·2	83·1	80·5	74·2	67·4	76·9
Sibsāgar	59·8	63·2	69·6	74·5	78·8	82·9	84·0	83·5	82·2	77·8	69·0	61·1	73·9
Patna	61·6	65·9	77·5	87·1	89·0	88·2	85·0	84·3	84·5	80·4	71·1	62·9	78·1
Jubbulpore	62·8	67·4	76·8	86·3	92·3	87·7	80·3	79·3	80·1	75·7	67·5	61·5	76·5
Hazāribāgh	61·8	66·3	76·2	85·3	87·4	84·2	79·2	78·5	78·5	75·1	67·6	61·4	75·1
Agra	61·1	65·5	76·9	88·2	94·4	94·4	86·9	85·0	84·9	80·5	70·2	62·5	79·2
Jaipur	61·3	65·3	75·3	86·4	92·4	91·8	85·9	83·9	83·9	79·2	70·5	63·4	78·3
Deesa	67·3	70·8	80·0	88·0	92·1	91·3	84·7	82·3	83·4	81·9	74·6	69·1	80·4
Karāchi	65·7	68·9	76·1	81·9	85·8	88·1	85·6	83·5	82·9	81·3	74·6	68·1	78·6
Jacobābād	58·5	63·2	75·4	86·4	94·9	98·6	96·1	92·6	89·8	80·6	68·8	60·4	80·4
Lahore	54·9	58·4	69·7	81·3	89·2	93·4	90·0	88·0	85·8	77·1	65·2	56·8	75·8
Rāwalpindi	50·5	53·1	63·6	74·2	83·4	89·1	87·0	84·6	81·3	72·0	60·3	52·4	71·0
Peshāwar	51·6	54·4	64·0	73·9	84·3	91·6	91·2	88·5	83·1	72·8	61·1	53·3	72·5

APPENDIX C

Average mean Temperature (Fahrenheit) of twelve representative Hill Stations

Station.	Elevation in feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Leh . .	11,503	19°·3	20°·6	32°·1	44°·0	50°·4	58°·9	64°·4	63°·6	55°·9	44°·3	34°·1	24°·0	42°·6
Kyelang .	10,087	24·4	23·7	31·5	42·1	50·1	58·6	62·5	62·0	55·6	46·0	38·6	29·4	43·7
Srīnagar .	5,204	32·7	34·8	46·3	56·8	64·5	71·0	74·8	73·4	66·2	54·8	46·0	38·2	55·0
Murree .	6,333	41·2	41·3	50·8	60·6	68·2	73·1	69·8	67·7	66·3	61·3	53·3	45·9	58·3
Simla .	7,224	39·5	40·8	51·2	58·7	65·9	67·7	64·7	63·3	61·3	56·7	50·6	44·3	55·4
Chakrātā .	7,022	43·4	43·7	53·0	61·2	65·5	67·2	65·1	64·2	62·9	58·6	52·0	47·1	57·0
Mussoorie .	6,705	43·3	43·9	52·9	63·2	68·1	68·7	65·8	64·5	63·1	58·2	51·5	45·8	57·4
Rānīkhet .	6,069	47·3	48·2	57·2	66·0	69·4	70·5	68·5	67·3	66·3	61·7	54·9	50·1	60·6
Darjeeling	7,376	40·8	41·8	49·4	55·6	58·2	60·7	61·9	61·4	59·8	55·2	48·3	42·7	53·0
Mount Abu	3,945	58·9	61·2	69·6	77·4	79·7	75·7	70·2	68·1	70·0	71·6	65·7	60·8	69·1
Pachmarhī	3,528	59·4	63·5	72·4	81·1	85·1	79·0	71·9	70·9	71·8	68·9	62·3	58·0	70·4
Wellington	6,200	56·4	58·0	63·2	65·9	67·1	65·1	64·5	64·3	63·6	62·0	59·7	57·2	62·3

Bibliography

The following publications of the Indian Meteorological Department, which are procurable at Calcutta, deal with the matters treated in this chapter:—

1. Handbook of Cyclonic Storms in the Bay of Bengal for the use of Sailors, vol. i, Text; vol. ii, Plates.

2. Rainfall Map of India in two sheets, scale 64 miles to 1 inch, showing the annual distribution of rainfall in India (in colours).

3. Instructions to Observers of the Indian Meteorological Department, in which are described in detail the various instruments in use at the observatories.

4. Barometer, Wind, and Current Charts of the Bay of Bengal and adjacent sea north of the equator.

5. Charts of the Bay of Bengal and adjacent sea north of the equator, showing the specific gravity, temperature, and currents of the sea surface.

6. Barometer, Wind, and Current Charts of the Arabian Sea and the adjacent portion of the North Indian Ocean.

7. Monthly Weather Review of India, giving a summary of the chief features of the weather in India and containing discussions on atmospheric pressure, barometric depressions, temperature of the air, winds, rainfall, &c. This also contains all available information about snowfall in the mountain districts to the north and north-west of India, and an abstract of observations taken at about 200 observatories in India.

8. Annual Summary of the Monthly Weather Review, giving a discussion of the meteorological data of India for the year.

9. India Daily Weather Report and Chart, containing observations recorded at 8 a.m. at 168 observatories, with a chart showing the distribution of atmospheric pressure and rainfall all over India, and a brief summary of the chief features of the weather of the day.

10. Indian Meteorological Memoirs, giving discussions and researches of meteorological data for India and neighbouring countries, illustrated by charts, plates, and curves, vols. i–xi. Blanford's memoir on *The Rainfall of India*, published in 1886, forms one of the volumes of this series.

11. Indian Special Cyclone Memoirs, giving full accounts of the most important cyclones and cyclonic storms which have occurred in India during the past thirty years.

12. A Handbook of the Meteorology of India, by Sir John Eliot, is now (1906) under preparation.

13. A Climatological Atlas of India, by Sir John Eliot, is also now (1906) under preparation.

CHAPTER IV

BOTANY[1]

THE term British India as employed in this chapter embraces, over and above the vast territory controlled by the Government of India, some independent countries, of which Nepāl and the Himālayas east of Sikkim are the chief, together with Ceylon and the Malayan Peninsula, which are in great part under the Colonial Office. Introductory.

The geographical and climatal features of India, upon which the distribution of its Flora so much depends, can be here introduced only incidentally. They will be found to be fully discussed in chap. i of this volume[2].

The term Flora applies in this sketch to native Flowering plants, Ferns and their allies. Collected materials do not exist for discussing the distribution of Mosses, Hepaticae, Lichens, and Fungi, which abound in most parts of India, or of the Algae in its seas and fresh waters. On the other hand, such extensive herbaria of the higher Orders of plants have, during the last century especially, been made over most parts of British India, that the study of their contents may be assumed to provide sufficient materials for a review of its Flora.

The Flora of British India is more varied than that of any other country of equal areā in the eastern hemisphere, if not in the globe. This is due to its geographical extension, embracing so many degrees of latitude, temperate and tropical; to its surface, rising from the level of the sea to heights above the limits of vegetation; to its climates, varying from torrid to arctic, and from almost absolute aridity to a maximum of humidity; and to the immigration of plants from widely different bordering countries, notably of Chinese and Malayan

[1] In compiling this Sketch I have had the advantage of receiving valuable facts and suggestions from Sir G. King, K.C.I.E., F.R.S., late Director of the Royal Botanic Gardens, Calcutta, and J. S. Gamble, M.A., C.I.E., F.R.S., late of the Indian Forest Department.

[2] See also *Introductory Essay to the Flora Indica*, by J. D. Hooker and Thomas Thomson, pp. 280, with two maps (London: Pamplin & Co., 1855).

on the east and south, of Oriental[1], European, and African on the west, and of Tibetan and Siberian on the north. Whether India is richer in number of genera and species than any other area on the globe of equal dimensions is doubtful; it is certainly far poorer in endemic genera and species than many others, especially China, Australia, and South Africa.

Of the elements of the Indian Flora the Malayan is the dominant; but until the Floras of Sumatra, Tongking, and South China are better known, it is not possible to estimate its comparative strength. The Oriental and European elements can be approximately estimated. About 570 European genera and 760 species are indigenous in India, of which about 430 genera and over 400 species are British; and if the Oriental genera and species be added to the European, these figures would probably be doubled. The African element, which includes the Arabian, is third in amount, and it will no doubt be augmented as the Flora of Equatorial Africa becomes better known. The Tibetan and Siberian elements, which include an Arctic, are all but confined to the alpine regions of the Himālayas. Lastly, the Chinese and Japanese Floras are strongly represented throughout the temperate Himālayas and in Burma.

Of the Natural Orders of Flowering plants, Ferns and their allies comprised in the Flora of British India, not one is peculiar to it; and if the genera common to it and to one or more of the adjacent countries be excluded, few endemic genera remain, and such of them as are endemic are local, and with few exceptions are restricted to one or few species[2]. It may hence be affirmed that in a large sense there is no Indian Flora proper[3].

[1] The term 'Oriental' is unfortunately used in a very different sense by botanists and by zoologists. In 1755 it was adopted by Gronovius as the title, 'Flora Orientalis,' of his work on the plants of the Levant and Mesopotamia; and it is the title of Boissier's great Flora of the East, from Greece to Afghānistān inclusive. This meaning has long been accepted by botanists. In zoological literature, 'Oriental' is more synonymous with Eastern India.

[2] Of these exceptions perhaps the most notable one is that of two genera of *Dipterocarpeae*, *Doona* with eleven species and *Stemonoporus* with fifteen, which are both confined to Ceylon.

[3] Mr. C. B. Clarke, in a most instructive essay 'On the Botanical Subareas of British India,' has speculated on the successive periods at which the component elements of the Flora were introduced, and has arrived at the following division: (1) The Deccan or Indo-African, (2) the Malayan, (3) the Central Asian, (4) the European. Mr. Clarke's Sub-areas approximately correspond with the Regions of this Sketch. See *Journal of the Linnean Society*, Bot., vol. xxxiv (1898), p. 142.

The British Indian Flora, though so various as to its elements, presents few anomalies in a phytogeographic point of view. The most remarkable instances of such anomalies are the presence in it of one or a few species of what are very large and all but endemic genera in Australia: namely, *Baeckea*, *Leptospermum*, *Melaleuca*, *Leucopogon*, *Stylidium*, *Helicia*, and *Casuarina*. Others are *Oxybaphus himalaicus*, the solitary extra-American species of the genus; *Pyrularia edulis*, the only congeners of which are a Javan and a North American; and *Vogelia*, which is limited to three species, an Indian, South African, and Sokotran. Of absentee Natural Orders of the Old World, the most notable are *Myoporineae*, which, though mainly Australian, has Chinese, Japanese, and Mascarene species; *Empetraceae*, one species of which girdles the globe in the north temperate hemisphere and reappears in Chili (the rarity of bog-land in the Himālayas must be the cause of its absence); and *Cistineae*, an Order containing upwards of 100 European and Oriental species, of which one only (a Persian) reaches Native Baluchistān. The absence of any indigenous Lime (*Tilia*) or Beech (*Fagus*) or Chestnut (*Castanea*) in the temperate Himālayas is remarkable, all three being European, Oriental, and Japanese genera. The Chestnut, which has been introduced into NW. India from Europe, ripens its fruit in the Western Himālayas.

With the exception of the Rhododendron belt in the high Eastern Himālayas, there are in India few assemblages of species of peculiar or conspicuous plants giving a character to the landscape over wide areas, as do the Heaths in Britain, the Heaths and succulent plants in South Africa, the *Eucalypti*, *Epacrideae*, and *Proteaceae* in Australia, the *Cacti* in America, or the great Aloes and Euphorbias in East Tropical and South Africa; nor are there representatives of the Pampas, Catingas, Savannahs, or Prairie vegetation of America. The Coniferous forests of the Himālayas resemble those of other northern countries, and the great Teak forests have no peculiar features[1]. The wood-oil trees (*Dipterocarpi*) in Burma form an exception, towering over the forests of Arakan and Tenasserim. Of gregarious trees, some of the most conspicuous are the Sāl (*Shorea robusta*),

[1] For an account of the Indian forests reference must be made to the chapter on Forests in this *Gazetteer* (Vol. III, ch. ii), and for details to Gamble's *Manual of Indian Timbers* (London, 1902). In the latter invaluable work, 4,749 woody plants are recorded for British India (exclusive of those of the Malayan Peninsula); and of these 2,513 are trees, 1,429 shrubs, and 807 climbers.

Eng or In (*Dipterocarpus tuberculatus*), Sissū (*Dalbergia Sissoo*), Khair (*Acacia Catechu*), and Babūl (*A. arabica*).

Indigenous Palms are few compared with many regions in tropical America, and are comparatively unobtrusive. The Talipot Palms (species of *Corypha*) are the most majestic palms in India, in stature, foliage, and inflorescence, but they are exceedingly rare and local. The Indian Date (*Phoenix sylvestris*), the Fan-Palm or Palmyra (*Borassus flabellifer*), and the Coco-nut near the sea, are the only palms that may be said to be conspicuous in the landscape of the plains of India. On the other hand, graceful erect or climbing Palms with pinnate or fan-shaped leaves frequent the humid evergreen forests, where the Rattans (*Calami*) ascend the trees by their hooked spines and expose their feathery crowns to the light. Bamboos, of which there are more than 120 kinds in India, form, as elsewhere in the tropics, an important feature, whether as clumps growing in the open, or forming in association all but impenetrable jungles; the taller kinds monopolize large areas in the hot lower regions, and the smaller clothe mountain slopes up to 10,000 feet in the Himālayas. Tree-ferns, of which there are about twenty (?) species, frequent the deepest forests of the Eastern Himālayas, Central India and Vizagapatam, Burma, Malabar, the Malay Peninsula, and Ceylon.

Of shrubs that form a feature in the landscape from their gregarious habits, the most conspicuous examples are the Rhododendrons of the temperate regions of the Himālayas, and the genus *Strobilanthes* in the western hills of the Peninsula. Many species of the latter genus do not flower till they have arrived at a certain period of growth, and then, after simultaneously flowering, seed profusely and die. Some Bamboos, also gregarious, display the same habit, which they retain under cultivation in Europe. Three local all but stemless Palms are eminently gregarious: *Phoenix farinifera* of the Coromandel coast, *Nannorrhops Ritchieana* of extreme Western India, and *Phoenix paludosa* and *Nipa fruticans* of the Sundarbans. Among herbaceous plants the beautiful genus *Impatiens* takes the first place, from abounding in all humid districts except the Malay Peninsula, and from its numerous species being (with hardly an exception) endemic; added to which is the fact that, though profuse in individuals, the species are remarkably local, those of the Eastern Himālayas differing from those of the Western, these again from the Burmese, and all from those of the Eastern and Western Peninsulas and Ceylon; and most of these two last from one another.

Of fresh-water flowering plants, floating or wholly or partially submerged, there are many kinds in India. They include the beautiful white, red, and blue *Nymphaeas*, *Nelumbium speciosum*, and *Euryale ferox*, the latter a near ally of the *Victoria Regina* of South American waters; also many carnivorous Bladderworts (*Utricularia*), and the curious *Aldrovanda* with leaves like those of the Venus Fly-trap, a South European plant, hitherto found nowhere in India except in some saline ponds near Calcutta. The most remarkable among the Indian fresh-water plants are the Podostemonads, which clothe rocks and stones in rapid streams with submerged spreading fronds, resembling green Lichens more than flowering plants. They are most common in Malabar and Ceylon, and are never found in rivers that have glacial sources. Marine flowering plants are few indeed, and are mostly of wide Oceanic distribution. Of peculiar littoral sand-hill plants there are few, the most notable being the above-mentioned *Phoenix farinifera*, *Ipomoea biloba*, *Vigna lutea*, *Canavalia lineata*, *Launaea pinnatifida*, and a curious grass, *Spinifex*, of Australian affinity. The estuarial plants will be enumerated when describing the tidal flora of the Sundarbans.

The number of recorded species of Flowering plants in India approaches 17,000[1], under 174 Natural Orders[2]; and there are probably 600 species of Ferns and their allies.

The largest Order of Flowering plants in all India is *Orchideae*, of which more than 1,600 species are recorded and additions are constantly being discovered. The greater number of these are tropical and epiphytic, and with comparatively few exceptions all are endemic. Ten are European, and they are British[3]. It is only in the Eastern Himālayas, Burma, and the Malay Peninsula that the Order predominates; in other parts of India *Leguminosae*, *Gramineae*, and *Euphorbiaceae* outnumber them.

[1] In the *Flora of British India* (1872–1897) about 15,900 species of Flowering plants are described. But since the publication of the first volumes of that work the greater part of Burma has fallen under British rule, and large accessions have been made to the Indian Flora from that and other quarters, especially from the Malay Peninsula.

[2] In the *Genera Plantarum*, by G. Bentham and J. D. H. (1862–1883), 200 Natural Orders of Flowering plants are described. Some of these have been rightly subdivided by earlier or later authors.

[3] *Corallorhiza innata*, *Goodyera repens*, *Spiranthes autumnalis*, *Listera ovata*, *Epipogum aphyllum*, *Cephalanthera ensifolia*, *Epipactis latifolia*, *Orchis latifolia*, *Habenaria viridis*, *Herminium Monorchis*. All these are temperate Western Himālayan; a few are also Eastern.

The ten dominant Orders of Flowering plants in all British India are in numerical sequence :—

1. *Orchideae.*	6. *Acanthaceae.*
2. *Leguminosae.*	7. *Compositae.*
3. *Gramineae.*	8. *Cyperaceae.*
4. *Rubiaceae.*	9. *Labiatae.*
5. *Euphorbiaceae.*	10. *Urticaceae.*

Of these all but *Labiatae* and *Compositae* are more tropical than temperate. *Compositae* take a very low place, and would, but for the temperate and alpine Himālayan species, take a very much lower. In this respect India shares, with the whole Malayan Archipelago, an exceptional poverty in what is not only the largest of all the Orders of Flowering plants in the world, but the one that heads the list in most other parts of the globe.

The following data[1], deduced from the whole Indian Flora, are of use for comparison with those of its several botanical areas. The proportion of Monocotyledons to Dicotyledons is approximately as 1 to 2·3; of genera to species as about 1 to 7. Of Palms there are more than 230 recorded species; of Bamboos, 120; of Conifers, only twenty-two; of *Cycadeae*, five. Of genera with 100 or more species there are ten, of which four are Orchids, headed by 200 of *Dendrobium*; the others are *Impatiens* (which will probably prove to be the largest genus of Flowering plants in India), *Eugenia*, *Pedicularis*, *Strobilanthes*, *Ficus*, *Bulbophyllum*, *Eria*, *Habenaria*, and *Carex*.

Botanical Regions of British India.

British India is primarily divisible into three botanical areas: a Himālayan, an Eastern, and a Western. The two latter are roughly limited by a line drawn meridionally from the Himālayas to the Bay of Bengal. The prominent characters of the three are—that the Himālayan area presents a rich tropical, temperate, and alpine Flora, with forests of Conifers, many Oaks, and a profusion of Orchids; that the Eastern has no alpine Flora, a very restricted temperate one, few Conifers, many Oaks and Palms, and a great preponderance of Orchids; that the Western has only one (very local) Conifer, no Oaks, few Palms, and comparatively few Orchids. Further, the Himālayan Flora abounds in European and Siberian genera; the Eastern in Chinese and Malayan; the Western in European, Oriental, and African. These three botanical areas are divisible into nine botanical Regions, for the determination of which I have, after long deliberation, resorted to the number of species of the ten

[1] It need hardly be pointed out that throughout this Sketch numbers are approximate only, and are liable to revision.

largest Natural Orders in each Region as the leading exponent of their botanical differences. The nine Regions are:—

1. The Eastern Himālayas, extending from Sikkim to the Mishmi mountains in Upper Assam.

2. The Western Himālayas[1], extending from Kumaun to Chitrāl.

3. The Indus Plain, including the Punjab, Sind, and Rājputāna west of the Arāvalli range and Jumna river, Cutch, and Northern Gujarāt.

4. The Gangetic Plain, from the Arāvalli hills and Jumna river to Bengal, the Sundarbans, the plains of Assam and Sylhet, and the low country of Orissa north of the Mahānadī river. This Region is divisible into three Sub-regions: an upper dry, a lower humid, and the Sundarbans.

5. Malabar in a very extended sense—the humid belt of hilly or mountainous country extending along the western side of the Peninsula from Southern Gujarāt to Cape Comorin. It includes Southern Gujarāt, the Southern half of Kāthiāwār, the Konkan, Kanara, Malabar proper, Cochin, Travancore, and the Laccadive Islands.

6. The Deccan in a very broad sense: that is, the whole comparatively dry elevated table-land of the Peninsula east of Malabar and south of the Gangetic and Indus Plains, together with, as a Sub-region, the low-lying strip of coast land extending from Orissa to Tinnevelly, known as the Coromandel coast.

7. Ceylon and the Maldive Islands.

8. Burma, bounded on the N. and NE. by the flanking mountains to the south of the Assam valley and China, on the east by China and Siam, on the west by Bengal and the Indian Ocean, and on the south by the State of Khedah in the Malay Peninsula. The Andaman Islands, and possibly the Nicobar, belong to the Burmese Region.

9. The Malay Peninsula, from Khedah to Singapore, including the British protected States in this Peninsula. The British Provinces proper are Wellesley, the Island of Penang, Malacca, and Singapore. The Nicobar Islands may belong to this Region.

[1] The independent Kingdom of Nepāl, extending for 500 miles between the Eastern and Western Himālayas, is here left out of account, from ignorance of its Flora. Except a very limited collection made in the valley of Kātmāndu by Wallich in 1821, the Flora of Nepāl is all but unknown. Great as are the differences between the Floras of Sikkim and Kumaun, the two meet in Nepāl, as indicated by Wallich's collections, which further contain a considerable number of endemic species.

A glance at the map of India shows that, in the attempt to delimit these botanical Regions geographically, large areas are in some cases difficult to apportion: as, for example, Kāthiāwār, of which the NW. half is probably referable botanically to Sind, the SE. to the Konkan. It is not possible to draw a bounding line between the Flora of the Indus and of the Gangetic Plains: that is, between the Flora of the affluents (in the plains) of the Sutlej and of the Jumna rivers. Extensive tracts of land with characteristic Upper Gangetic plants intrude into the Indus Plain, and desert areas of Rājputāna intrude into the Gangetic Plain. The eastern limit of the Malabar Region is undefinable, because of the number of spurs and valleys from its hills which project far into the Deccan Region, sometimes almost crossing it, carrying with them types of the Malabar Flora, which towards its northern limit mingles with those of the Deccan and of the Indus and Gangetic Plains. The Flora of the trans-Indus mountains bounding the Indus Plain Region on the west, of which the eastern flanks are British Indian, is known botanically in one valley only, the Kurram. To have referred this either to the Western Himālayan Region, or to Afghānistān, would be premature. It is therefore treated of in an Appendix (A) to this Sketch; as is also the Flora of British Baluchistān (Appendix B), which differs considerably from that of any other botanical Region of India.

These Regions coincide roughly with the areas of comparative humidity or dryness, indicated by Major Prain in his *Plants of Bengal* (Introduction, p. 2) as follows:—

India Deserta; Sind, Rājputāna, and the Punjab. (The Indus Plain Region.)

India Diluvia; with its chief development in the Gangetic Plain, comprising much of the territory that constitutes politically the United Provinces and Bengal. (The Gangetic Plain Region.)

India Aquosa; the wet forest tracts along the Western Ghāts from Gujarāt to Travancore, which receive all the force of the SW. monsoon. (The Malabar Region.)

India Vera; the dry but not desert triangle between the Western and the Eastern Ghāts of the Peninsula, with its apex in Tinnevelly, and its base skirting the Gangetic Plain. (The Deccan Region.)

India Subaquosa; the Eastern Ghāts and the strip between them and the sea. (The Coromandel Sub-region.)

India Littorea; most highly developed in the Gangetic delta. (The Sundarbans Sub-region.)

They also approximate to the botanical Sub-areas of British India drawn up by Mr. C. B. Clarke in his instructive Essay in the *Journal of the Linnean Society* (vol. xxxiv (1898), p. 142), with an excellent map. The principal differences between his Sub-areas and my Regions lie in his inclusion of Central Nepāl in the Eastern Himālayan Region, and of the Afghān E. boundary mountains, all Baluchistān, SE. Rājputāna, and Central India in the Indus Plain Region; in his treatment of N. and NE. Burma with the Assam Valley as a separate Sub-area (Assam), and of Eastern and Southern Burma as another (Pegu); and in his inclusion of all Ceylon in the Deccan Region.

The Flora of British India has been described at much greater length than in this Sketch in the Introductory Essay to Dr. Thomson's and my *Flora Indica* (see footnote, p. 157). In that work three primary divisions are recognized[1]: namely, I. Hindustān, including the Western Peninsula from the base of the Himālaya to Cape Comorin; II. The Himālayas; III. India beyond the Ganges. These primary divisions are subdivided into sixty-four Provinces, the botanical characters of which, as far as they were then known, were delimited in relation to their climate, geographical position, elevation above the sea, and other physical conditions; to which are added references to many of the botanists who had explored them, their collections and their works. These sixty-four Provinces will, I believe, all prove to be deserving of detailed botanical treatment when sufficient materials shall have been obtained to effect this. The following is a list of them, arranged under the Regions adopted in this Sketch:—

1. Eastern Himālayas: Mishmi, Abor, Bhutān, Sikkim, Central Nepāl.

2. Western Himālayas, under three groups: I. Kumaun, Garhwāl, Simla, Kulū, Chamba, Jammu, Rajaori; II. Kanāwar, Lāhul, Kishtwar, Kashmīr, Murree; III. Gugi, Piti and Parang, Zāskār, Dras, Nari, Ladākh, Bālti, Nubra.

3. Indus Plain, which includes the Punjab, Sind, Cutch, Northern Gujarāt, and Rājputāna west of the Arāvalli Hills.

4. Gangetic Plain, under two groups: I. Upper, including Rājputāna east of the Arāvalli Hills, Bundelkhand, and Mālwā

[1] A fourth is devoted to Afghānistān and Baluchistān, which countries not being in British India are not included in this Sketch, except a small area in Baluchistān since acquired. See Appendix B, p. 209.

north of the Vindhya range; II. Lower, including Bengal south of the Himālayas, Orissa north of the Mahānadī, the Assam, Sylhet, Cāchār, and Tippera plains.

5. Malabar, including Khāndesh, the Konkan, Kanara, Coorg, Malabar proper, Travancore.

6. The Deccan, including Mālwā, Bihār, Berār, Central India, the Central Provinces, Chotā Nāgpur, Orissa south of the Mahānadī, the Deccan proper, Mysore, and the Coromandel coast.

7. Ceylon.

8. Burma, including the Assam, Gāro, Pātkai, Nāgā, Khāsi, Manipur, Cāchār, and Sylhet Hills, Chittagong, Tippera, Arakan, Pegu, and Tenasserim, together with the Shan and other States bordering China and Siam.

9. The Malayan Peninsula, including the British and Siamese States therein.

The Eastern Himālayan Region.

The only botanically well-known portion of the first Region is its western end: Sikkim, an oblong section of the Himālayas about 100 miles long from north to south, and forty from east to west. An analysis of its Flora may be presumed to give an adequate idea of the general features of the unexplored Himālayas to the eastward of it. This is indeed proved by such materials as have been procured from the latter[1].

A comparison of its vegetation with that of the Western Himālayas will be found under that Region.

Sikkim is the most humid district in the whole range of the Himālayas, because of its proximity to the Bay of Bengal and direct exposure to the effects of the moisture-laden south-west monsoon, from which the ranges east of Sikkim are partially screened by the mountains on the south flank of the Assam valley. It is estimated to contain about 4,000 species of Flowering plants under 160 Natural Orders; also 250 Ferns

[1] Of the Flora of the Mishmi Hills the only account is that of Griffith, who visited them in October to December, 1836, collecting upwards of 900 species of Flowering plants and 224 of Ferns and their allies. According to a list which he drew up and which is published in his 'Posthumous Papers' (vol. i, p. 57, Calcutta, 1847), the following is a decad of the largest Natural Orders, with the number of species in each: 1. *Compositae*, 80; 2. *Gramineae*, 73; 3. *Labiatae*, 50; 4. *Orchideae*, 43; 5. *Rubiaceae*, 42; 6. *Acanthaceae*, 38; 7. *Leguminosae*, 31; 8. *Cyperaceae*, 22; 9. *Gesneraceae*, 22; 10. *Euphorbiaceae*, 21. Most of these are presumably from the tropical zone. The predominance of *Compositae* is notable. It was during this visit that Griffith discovered the remarkable stemless and leafless root-parasite *Sapria himalayana*, a near ally of *Rafflesia Arnoldi*, which added the Natural Order *Cytinaceae* to the Himālayan Flora. It has not since been collected.

and their allies, of which eight are Tree-ferns. The ten dominant Orders are the following, to which are appended, in brackets, their relative places in the Western Himālayan decad:—

1. *Orchideae* (7).	6. *Urticaceae.*
2. *Gramineae* (1).	7. *Scrophularineae* (10).
3. *Leguminosae* (3).	8. *Rosaceae* (8).
4. *Compositae* (2).	9. *Rubiaceae.*
5. *Cyperaceae* (5).	10. *Euphorbiaceae.*

The proportion of Monocotyledons to Dicotyledons in Sikkim is about 1 to 2·5. Its Flora is disposed in three altitudinal zones: tropical, temperate, and alpine. It is difficult to limit, even approximately, the elevation of these zones above the sea, many tropical species ascending far into the temperate, and temperate species descending into the tropical. So too with the alpine zone, many of its species descend far into the temperate, and temperate species ascend far into the alpine. Assuming the normal tropical Flora to ascend from the level of the plains of India to 6,500 feet, and the normal alpine to descend from 18,000 to 12,000 feet, the number of species normal to each zone may possibly be found to approximate to 2,000, 1,500, and 500. The total number of recorded species of Orchids in Sikkim is 440; of Palms, twenty; of *Bambusae*, about twenty-three; and of Ferns and their allies, 280, of which eight are Tree-ferns.

Tropical zone of Sikkim.

The tropical zone of Sikkim is skirted at its base by a low belt about 20 miles broad, which gradually slopes upwards from the level of the plains of Bengal to the foothills of the zone at 1,000 feet elevation, from which the ascent is rapid to 6,500 feet and upwards. This belt was, when Sikkim was first botanically explored (in 1848), a deadly, unhealthy tarai[1], covered with a loose forest (now for the most part cleared away) of trees common in the hotter parts of India, especially the Sāl (*Shorea robusta*), together with a rich undergrowth of shrubs, coarse grasses, and the herbaceous plants of the Gangetic Plain. Among them a few species of the temperate zone occur, brought down by the streams from higher levels. The foothills and spurs of the tropical zone are (or were before the introduction of tea cultivation) clothed throughout with a dense

[1] The term 'tarai' as used in Sikkim is a misapplication of the word, as understood throughout the Western Himālayan Region. In the latter region a similar belt skirting the foothills is known as the 'bhābar,' and the 'tarai' is a more or less swampy belt along the foot of the 'bhābar.'

forest, Malayan in general character. The ten dominant Orders of the tropical zone are, in numerical sequence:—

1. *Orchideae.*	6. *Cyperaceae.*
2. *Leguminosae.*	7. *Rubiaceae.*
3. *Gramineae.*	8. *Compositae.*
4. *Urticaceae.*	9. *Asclepiadeae.*
5. *Euphorbiaceae.*	10. *Acanthaceae.*

There are in this zone about 850 trees and shrubs, many of them timber trees, among the most conspicuous of which are (beside the Sāl), species of *Magnoliaceae*, *Anonaceae*, *Guttiferae*, *Sterculiaceae*, *Tiliaceae*, *Meliaceae*, *Sapindaceae*, *Anacardiaceae*, *Leguminosae*, *Combretaceae*, *Myrtaceae*, *Lythraceae*, *Rubiaceae*, *Bignoniaceae*, *Laurineae*, *Euphorbiaceae*, *Urticaceae*, and *Myristicaceae*.

There are four species of Oak, as many of *Castanopsis* (a genus allied to *Castanea*), *Luculia gratissima*, the two paper-yielding shrubs, *Daphne cannabina* and *Edgeworthia Gardneri*, a Poplar, a Willow (*Salix tetrasperma*), one Pine, in the inner valleys only (*P. longifolia*), a *Cycas* and two species of *Musa*, eighteen indigenous Palms, a dwarf and a tall *Pandanus*, and twelve arborescent or frutescent Bamboos. Ferns abound. Of shrubs, *Acanthaceae* and *Melastomaceae*, together with others of the above arboreous Orders, are among the most frequent. Of climbers, there are many species of *Ampelideae*, *Cucurbitaceae*, *Convolvulaceae*, *Apocyneae*, *Asclepiadeae*, *Smilax*, *Dioscorea*, and *Aroideae*. Herbaceous plants are well represented by *Malvaceae*, Balsams, Orchids, and *Scitamineae*, together with many species of other ubiquitous tropical Indian Orders.

Temperate zone of Sikkmi.

The temperate zone of Sikkim, from 6,500 to 11,500 feet, is roughly divisible into a lower non-coniferous and an upper coniferous and Rhododendron belt; but the line of demarcation between these varies so greatly with the exposure and humidity of the locality that they cannot be dealt with apart. Of about 100 Natural Orders of Flowering plants that occur in this zone the following ten dominate, the figure in brackets after each Order denoting its relative position in the tropical zone:—

1. *Orchideae* (1).	6. *Geraniaceae.*
2. *Compositae* (8).	7. *Ericaceae.*
3. *Gramineae* (3).	8. *Liliaceae.*
4. *Rosaceae.*	9. *Labiatae.*
5. *Cyperaceae* (6).	10. *Umbelliferae.*

Of the above Orders the *Orchideae* alone are strongly

Malayan in character, the others are mostly European, Central Asian, Japanese, or Chinese. The most conspicuous trees are *Magnoliaceae* (five species), of which one (*Magnolia Campbellii*), before the working of the forest began, clothed the slopes around Darjeeling, starring them in spring, when still leafless, with its magnificent flowers. Other conspicuous trees of this region are Oaks, Laurels, Maples, Birches, Alder, *Bucklandia*, *Pyrus*, and Conifers. Of these the Conifers are chiefly confined to a belt from 9,000 to 12,000 feet in elevation. The monarch and most common of them is a Silver Fir (*Abies Webbiana*), which is also the most gregarious; others are the English Yew, a Spruce (*Picea Morinda*), a Larch (*Larix Griffithii*, the only deciduous Conifer in the Himālayas), the weeping *Tsuga Brunoniana*, and two species of Juniper, both of which, in dwarf forms, ascend high into the alpine zone. The absence of any true Pine or Cypress in the forests of this region of the Himālayas is notable, in contrast with similar elevations in the Western Himālayas. Of shrubs, the most conspicuous are the Rhododendrons (twenty-five species), which abound between 9,000 and 12,000 feet elevation, some of them forming impenetrable thickets; a few of these are arboreous, though never attaining any considerable height. Other shrubs are species of *Clematis*, *Ternstroemiaceae*, *Berberideae*, *Ilex*, *Rosa*, *Rubus*, *Cotoneaster*, *Spiraea*, *Hydrangea*, *Aucuba*, *Lonicera*, *Leycesteria*, *Osmanthus*, *Osbeckia*, *Buddleia*, *Vacciniaceae* (some epiphytic), *Ericaceae*, Elder, *Viburnum*, *Polygonum*, Ivy, &c. Beautiful herbaceous plants abound—Anemones, Aconites, Violets, many species of Balsam, *Potentilla*, *Fragaria*, *Gentianeae*, *Campanulaceae*, *Gesneraceae*, *Scrophularineae*, *Orchideae* (*Coelogyne*, eight species), *Cypripedium*, *Polygonatum*, *Smilacina*, *Lilium*, *Fritillaria*, *Arisaema*. Only two Palms inhabit this zone, a scandent Rattan (*Plectocomia himalaica*), and very rarely a Fan-Palm (*Trachycarpus Martiana*). Dwarf Bamboos, of which there are six species, abound, some of them forming impervious thickets infested with leeches and large ticks. Ferns are characteristic of this zone.

Alpine zone of Sikkim.

The alpine zone of Sikkim descends to about 12,000 feet from the upper limit of the existence of Flowering plants. It presents two climates with conforming differences in their vegetation: a lower or outer humid, and an upper or inner dry Tibetan region. But the limits of these climates are not clearly definable either topographically or botanically; for whereas in some cases the passes between Sikkim and Tibet are abrupt and lofty, in others the valleys expand widely and

become gradually Tibetan in climate and features, the pass proper being a political boundary. Further, some valleys run up from south to north, others from west to east. The number of species of Flowering plants recorded for this zone is about 380, no doubt far below what future collectors will raise it to. They are included under forty-six Orders, of which the ten dominant are as follows, their corresponding position in the Western Himālayan decad being given in brackets:—

1. *Compositae* (1).	6. *Caryophylleae* (8).
2. *Scrophularineae.*	7. *Ranunculaceae* (6).
3. *Primulaceae.*	8. *Cyperaceae* (4).
4. *Saxifragaceae* (9).	9. *Gramineae* (2).
5. *Cruciferae* (5).	10. *Fumariaceae* (10).

Of the above, the first three greatly outnumber the others, some of which may have to give place to *Rosaceae*, *Gentianaceae*, or *Umbelliferae*. The largest genera are *Pedicularis*, *Primula*, *Corydalis*, and *Saxifraga*. The low position of *Cyperaceae* and *Gramineae* in the decad is notable, remarkably so in contrast to the Western Himālayan decad; but future herborizations may bring them up higher. The few trees, to be found only on the lower skirts of this zone, are scattered Birches and *Pyri*. The principal bushes are Rhododendrons (of which several species attain 14,000 feet elevation, and three dwarf ones 16,000 feet), two Junipers, species of *Ephedra*, *Berberis*, *Lonicera*, *Caragana*, *Rosa*, *Cotoneaster*, *Spiraea*, and dwarf Willows. Of Ferns there are very few. About thirty species reach 18,000 feet elevation, some of them a little higher. The highest recorded Flowering plant is a *Festuca* (not found in flower) at about 18,300 feet. In drier valleys above 15,000 feet elevation several species of *Arenaria* occur, which form hard hemispheric or globose white balls and are a characteristic feature in the desolate landscape. By far the most striking plants of this zone are the species of *Meconopsis*, *Rheum nobile*, the Edelweiss, many Primulas, *Tanacetum gossypinum*, *Saussurea obvallata* and *gossypifera*, and the odorous *Rhododendron Anthopogon*.

The Western Himālayan Region.

The Western Himālayan ranges differ greatly from the Eastern, in orientation, in greater length, higher latitude, cooler drier climate, and in the far greater breadth of the mountain mass west of the Sutlej. A transverse section drawn through the valley of Kashmīr, from the plain of the Punjab to the Kārakoram range, is three times as long as one drawn any-

where transversely across the Eastern Himālayas, and, unlike the latter, it presents a series of parallel snow-clad ranges, which have a general direction from SW. to NE. Of the valleys enclosed by these ranges, those towards the plains are very narrow, tortuous, and steep; the rearward, on the contrary, are more open, with elevated, often saline floors, and owing to the dryness of the air are either sterile or support a Tibetan vegetation. The latter valleys constitute Little Tibet, forming the western termination of the Great Tibetan plateau. It would appear from the above that the Western Himālayan Flora should greatly outnumber the Eastern in genera and species, and but for the dryness and reduced temperature of its tropical and temperate zones it would doubtless do so. But if it is borne in mind that no area in the Western Region of the dimensions of Sikkim is nearly so rich as the latter, and that the Flora of the Western is fairly well explored, while the Eastern, except in Sikkim, is all but unexplored, the conclusion must be that the latter will prove to be far the richer botanically.

Upwards of 4,000 Flowering plants are recorded as Western Himālayan, comprised in 147[1] Natural Orders, and there are also 230 Ferns and their allies. Of the former, the following ten are the dominant, the number in brackets indicating their corresponding positions in the Eastern Himālayan decad :—

1. *Gramineae* (2).
2. *Compositae* (4).
3. *Leguminosae* (3).
4. *Cyperaceae* (5).
5. *Labiatae*.
6. *Ranunculaceae*.
7. *Orchideae* (1).
8. *Cruciferae*.
9. *Rosaceae* (8)
10. *Scrophulariaceae* (7).

The proportion of Monocotyledons to Dicotyledons is about 1 to 3. Twelve Eastern Himālayan Orders here disappear: namely, *Dilleniaceae, Guttiferae, Passifloraceae, Stylidieae, Vacciniaceae, Diapensiaceae, Myristicaceae, Proteaceae, Cycadeae, Burmanniaceae, Xyrideae, and Pandaneae*, together with Tree-ferns and many Palms. With the exception of *Vacciniaceae* and *Diapensiaceae*, all are tropical. The following Orders that are absent in the Eastern Himālayas are found in the Western : *Moringeae, Polemoniaceae, Illecebraceae*, of which *Polemonium* alone is strictly temperate or sub-alpine. Of even greater significance is the removal of Orchids from the first to the seventh place in the above decad, and the replacement of the tropical Orders of *Urticaceae, Rubiaceae*, and *Euphorbiaceae* of the Eastern Region

[1] The Order *Platanaceae* is excluded, the Oriental Plane not being indigenous in any part of India.

by the temperate *Ranunculaceae*, *Cruciferae*, and *Labiatae* of the Western. Finally, an instructive example of the difference between the Eastern and Western Floras is afforded by a reference to the recently published *Flora Simlensis* by the late Colonel Sir Henry Collett. In that work, 1,326 Flowering plants are described, of which nearly one-third are absent from Sikkim.

The number of genera in the Western Himālayan Region (about 1,220) does not greatly exceed that in Sikkim, but no fewer than 250 of them are absent from the latter; almost all of them are European, thus demonstrating the preponderance of this element in the West. Selecting some of the most conspicuous of the typically European Orders common to the Eastern and Western Himālayas, and indicating by the letters E. and W. a rough approximation to the relative number of species under each, the following are the results:—

Cruciferae	$\frac{\text{W. }40}{\text{E. }18}$,	*Caryophylleae*	$\frac{\text{W. }19}{\text{E. }11}$,	*Umbelliferae*	$\frac{\text{W. }23}{\text{E. }15}$,
Compositae	$\frac{\text{W. }104}{\text{E. }57}$,	*Boragineae*	$\frac{\text{W. }76}{\text{E. }25}$,	*Labiatae*	$\frac{\text{W. }48}{\text{E. }35}$.
Chenopodiaceae[1]	$\frac{\text{W. }18}{\text{E. }3}$,	*Gramineae*	$\frac{\text{W. }100}{\text{E. }72}$,		

About 170 species of Orchids are recorded as West Himālayan, most of them being terrestrial, but few are of tropical type; a list of such as are European is given at p. 161, in a footnote. Of Palms there are six species; of *Bambuseae* seven.

Tropical zone of Western Himālayas.

The upper limit of this tropical zone of the Western Himālayas is lower by perhaps 1,000 feet than is that of the corresponding zone in Sikkim. Notwithstanding the absence of the above-mentioned tropical Orders, its general features are, in many respects, the same in both Regions. Proceeding northwestward, however, tropical species rapidly decrease in numbers, and before crossing the Indus the tropical zone has almost disappeared. As examples of this dying out of tropical types in the west the following fifteen are instructive, in which the letters E. and W. denote the two contrasted zones:—

Menispermaceae	$\frac{\text{E. }13}{\text{W. }6}$,	*Sterculiaceae*	$\frac{\text{E. }22}{\text{W. }15}$,	*Liliaceae*	$\frac{\text{E. }28}{\text{W. }16}$,
Meliaceae	$\frac{\text{E. }14}{\text{W. }6}$,	*Ampelideae*	$\frac{\text{E. }37}{\text{W. }19}$,	*Araliaceae*	$\frac{\text{E. }21}{\text{W. }10}$,
Begoniaceae	$\frac{\text{E. }16}{\text{W. }2}$,	*Myrsineae*	$\frac{\text{E. }18}{\text{W. }8}$,	*Gesneraceae*	$\frac{\text{E. }32}{\text{W. }9}$,
Piperaceae	$\frac{\text{E. }11}{\text{W. }5}$,	*Laurineae*	$\frac{\text{E. }44}{\text{W. }14}$,	*Urticaceae*	$\frac{\text{E. }110}{\text{W. }65}$,
Commelinaceae	$\frac{\text{E. }22}{\text{W. }9}$,	*Palmeae*	$\frac{\text{E. }20}{\text{W. }6}$,	*Bambuseae*	$\frac{\text{E. }17}{\text{W. }7}$.

[1] The absence of saline soil in Sikkim accounts for its poverty in this Order.

Among the most interesting tropical and sub-tropical trees and shrubs of the Western Himālayas that are absent in the Eastern are *Cocculus laurifolius*, *Boswellia thurifera*, *Pistacia integerrima*, the Pomegranate and Oleander, *Roylea elegans*, *Engelhardtia Colebrookeana*, and *Holoptelea integrifolia*, most of which are also Oriental. Of the disappearance of trees prevalent almost throughout the tropical zone of the Himālayas, that of the Sāl between the Rāvi and Chenāb rivers is a very notable instance.

The Orchids of this zone, especially the epiphytic, are few, and almost confined to the Districts of Kumaun and Garhwāl. There are only fifteen Dendrobes, all but one or two of which are also natives of Sikkim, where about forty are known. Of *Bulbophyllum* and *Cirrhopetalum*, only six species are recorded. The Palms are *Wallichia densiflora*, *Phoenix sylvestris*, *acaulis*, and *humilis*, and *Calamus tenuis*. The only common Bamboo is *Dendrocalamus strictus*.

Temperate zone of Western Himālayas.

Owing to the complexity of the mountain ranges, outer and inner, and the differences of their climates, it is very difficult to assign altitudinal limits to the temperate zone of the Western Himālayas. In Kumaun and Garhwāl I have estimated it as perhaps 1,000 feet lower than in Sikkim, but farther to the west and north observations are wanting for fixing it. The vegetation of the outer ranges is in character on the whole that of Sikkim, the difference being due mainly to the greatly increased number of European genera. All the Conifers of the Eastern Himālayas are present, except the Larch; and to these are added forests of Deodar, *Pinus longifolia* (a comparatively rare plant in Sikkim and there only tropical), *P. excelsa*, *Abies Pindrow*, *Cupressus torulosa*, *Juniperus macropoda*, and (in dry regions) *Pinus Gerardiana*, the first and three last giving, where found, a character to the landscape. Of Oaks there are six, four of them Sikkim species, two only being Western, of which one is the European Holm Oak (*Quercus Ilex*), which extends eastward to Kumaun at 3,000 to 8,500 feet elevation, and westward to Spain. The Indian Horse-Chestnut (*Aesculus indica*) represents the Eastern *Ae. punduana*. Two Birches and two Hornbeams are common to both Regions, but the Eastern-nut (*Corylus ferox*) is replaced by the Oriental *C. Colurna*.

Among other shrubs and small trees peculiar to the Western Himālayas are the Indian Bladder-nut and Lilac (*Staphylea Emodi* and *Syringa Emodi*), *Rosa Webbiana*, *moschata*, and *Eglanteria*, *Parrottia Jacquemontiana*, the Mountain

Ash (*Pyrus Aucuparia*), the Bullace (*Prunus insititia*), and the common Hawthorn. On the other hand, the most striking difference between the temperate Floras of the Eastern and Western Himālayas is the paucity of species of Rhododendron in the latter, where only four are found—all common, at their respective elevations, in Sikkim—*R. Anthopogon*, *barbatum*, *campanulatum*, and *arboreum*; the latter also inhabits the mountains of Southern Malabar, Burma, and Ceylon. Of European herbaceous plants there occur several hundreds unknown in Sikkim, as *Ranunculus aquatilis* and *R. Lingua*, *Caltha palustris*, *Nymphaea alba*, *Lythrum Salicaria*, *Menyanthes trifoliata*, and *Cladium Mariscus*, which all occur in the Lake of Kashmīr; also species of *Aquilegia* and *Paeonia*, *Parnassia palustris*, *Adoxa Moschatellina*, *Lysimachia vulgaris*, *Polemonium caeruleum*, *Eriophorum vaginatum*, and many Grasses, Rushes, and Sedges. The genus *Impatiens* abounds in the temperate zone, at all elevations except the highest, the species being with few exceptions endemic. The Orchids of this zone are almost uniformly terrestrial; they include several European species unknown in the Eastern Himālayas (see footnote, p. 161). The only Palm is a *Trachycarpus*, confined to and local in Kumaun and Garhwāl. Of Bamboos there are four, all dwarf and gregarious.

Alpine zone of Western Himālayas.

Assuming 11,000 to 12,000 feet as the lower limit of the alpine zone of the Western Himālayas in the outer ranges, and 18,000 feet as the normal upper limit of Flowering plants, about 600 species belonging to forty-eight Natural Orders are recorded as indigenous. Of these Orders the dominant ten are the following, with their relative positions in the alpine Sikkim decad indicated in brackets:—

1. *Compositae* (1).	6. *Ranunculaceae* (7).
2. *Gramineae* (9).	7. *Gentianeae*.
3. *Leguminosae*.	8. *Caryophylleae* (6).
4. *Cyperaceae* (3).	9. *Saxifragaceae* (4).
5. *Cruciferae* (5).	10. *Fumariaceae* (10).

Two Orders of the above decad, *Leguminosae* and *Gentianeae*, are absent in the corresponding Eastern one, where they are replaced by *Primulaceae* and *Scrophularineae*. I doubt, however, whether this and other comparisons will hold good when the alpine zone of Sikkim shall have been fully explored. As was to be expected, the Western alpine Flora is much richer than the Eastern, due to its greater area. The increment consists mainly of small European genera, and not in additions to

the large genera common to both; for taking twenty-nine of the latter, the sum of their species is nearly the same for both Regions, 277 in the Eastern, 266 in the Western; the close coincidence is of course accidental, but not the less instructive.

The genera in excess in the Eastern Himālayas are:—

Arenaria $\frac{E.\ 10}{W.\ 7}$, *Saxifraga* $\frac{E.\ 25}{W.\ 18}$, *Primula* $\frac{E.\ 24}{W.\ 11}$, *Rhododendron* $\frac{E.\ 10}{W.\ 2}$, *Pedicularis* $\frac{E.\ 40}{W.\ 18}$.

In excess in the Western Himālayas are:—

Astragalus $\frac{E.\ 6}{W.\ 22}$, *Caragana* $\frac{E.\ 1}{W.\ 6}$, *Tanacetum* $\frac{E.\ 2}{W.\ 11}$, *Artemisia* $\frac{E.\ 4}{W.\ 11}$, *Saussurea* $\frac{E.\ 13}{W.\ 20}$, *Nepeta* $\frac{E.\ 2}{W.\ 7}$, *Polygonum* $\frac{E.\ 7}{W.\ 16}$.

In the following large genera the numbers in each Flora are nearly equal: *Corydalis*, *Draba*, *Potentilla*, *Gentiana*, *Juncus*, *Carex*. The above data all point to a further great predominance of the Eastern Himālayan alpine Flora over the Western to be expected when the 500 miles of mountains east of Sikkim shall have been botanized[1].

Two of the most conspicuous alpine plants of Sikkim are absent in the Western Himālayas, *Rheum nobile* and *Tanacetum gossypinum*; the latter has, however, the remarkable *Saussurea obvallata* and *gossypiphora*, together with, in the driest regions, some cushion-formed species of *Arenaria*.

Tibetan valleys of Western Himālayas.

Ascending the Indus river a few tropical plants extend up to Gilgit (alt. 4,000 to 5,000 feet). At greater elevations the full effects are experienced of a dry climate, great cold alternating with fierce sun-heat, and consequent aridity. Between 12,000 and 14,000 feet the principal indigenous trees are *Populus euphratica* and *P. balsamifera*, and of shrubs or small trees *Ulmus parvifolia* and species of *Tamarix*, *Caragana*, *Rosa*, *Lonicera*, *Hippophae*, *Myricaria*, *Elaeagnus*, and *Salix*. The cultivated trees are the fruit-bearing European ones, with *Populus alba* and *P. nigra*. Above 14,000 and up to 18,000 feet is a region of alpine perennials of European, Oriental, and Central Asian Orders and genera, as *Fumariaceae*, *Leguminosae* (*Astragalus* especially), *Compositae*, *Labiatae*, and *Stipaceae*. The only Orchids are a few species of *Orchis* and *Herminium*. Above 17,000 feet, twenty-five genera are recorded, all (except *Biebersteinia*) European, and many of

[1] The only botanist who has written on the distribution of the plants of this Region is the late Dr. Thomas Thomson, F.R.S., who explored it in 1847 and 1848. See *Narrative of a Journey in the Western Himalaya and Tibet* (1852), and Introductory Essay to the *Flora Indica* (1855).

them British, as *Potentilla Sibbaldi* and *anserina*, *Saxifraga cernua*, and *Lloydia serotina*. The most typical plant of this region is *Arenaria rupicola*, which forms hard white cushions or balls a foot in diameter, apparently the growth of centuries. The genera *Astragalus*, *Saussurea*, *Artemisia*, *Tanacetum*, and *Allardia* have many endemic species at these elevations. Where saline soils occur *Chenopodiaceae* abound, with two endemic Crucifers (*Dilophia* and *Christolea*), also *Sonchus maritimus*, *Glaux maritima*, and *Triglochin maritimum*. The fresh-water plants of this region include *Ranunculus aquatilis*, *Hippuris vulgaris*, *Limosella aquatica*, and species of *Utricularia*, *Potamogeton*, and *Zannichellia*. Ferns are all but absent.

The Indus Plain Region.

Whether proceeding across the Indus Plain Region in a SW. direction from the Himālayas to Sind, or in a SE. from the Afghān border to Western Rājputāna, vegetation rapidly diminishes, approaching extinction in the Indian desert. Over the whole region a low, chiefly herbaceous vegetation of plants common to most parts of India, mixed with Oriental, African, and European types, is spread, with thickets of shrubs and a few trees. With few exceptions all have deciduous leaves, and most of the herbaceous are burnt or dried up in the hot season, the principal exceptions to the latter being *Chenopodiaceae*, which especially affect the frequent saline soils. On Mount Abu, an outlier of the Arāvalli Hills in the SE. of this region, 5,653 feet in elevation, more humid tropical types appear, with *Rosa Lyellii*, *Vogelia indica*, and an epiphytic orchid (*Aerides*); many cultivated fruits succeed in the villages, as the mulberry, tamarind, mango, guava, and custard apple.

From the scattered materials available it may be assumed that the Flora of this region may comprise about 1,500 indigenous Flowering plants, under 112 Orders, of which the following are the dominant ten, with, in brackets, their corresponding positions in the Gangetic Plain decad:—

1. *Gramineae* (1).	6. *Labiatae* (10).
2. *Leguminosae* (2).	7. *Boragineae*.
3. *Compositae* (4).	8. *Malvaceae* (6).
4. *Cyperaceae* (3).	9. *Euphorbiaceae* (8).
5. *Scrophularineae* (5).	10. *Convolvulaceae* (9).

Of the 112 Orders about thirty-five are represented by a single genus only, and thirteen by a single species. The number of monotypic genera is also very large. The high position of *Boragineae* is a marked feature. The chief arboreous vegetation consists of isolated groups of trees in the outskirts

of the Western Himālayan Region, on the banks of the rivers, and in the Ajmer forest on the flanks of the Arāvalli hills in Rājputāna[1]. The principal indigenous trees are *Tamarix articulata*, *Bombax malabaricum*, *Sterculia urens*, *Grewia salicifolia*, *Balanites Roxburghii*, *Boswellia serrata*, *Balsamodendron Mukul* and *pubescens*, *Pistacia integerrima*, *Aegle Marmelos*, *Odina Wodier*, *Moringa pterygosperma* and *concanensis*, *Dalbergia Sissoo*, *Butea frondosa*, *Prosopis spicigera*, *Acacia arabica*, *Jacquemontii leucophaea*, *eburnea*, *modesta*, and *rupestris*, *Dichrostachys cinerea*, *Salvadora persica* and *oleoides*, *Anogeissus pendula*, *Cordia Myxa* and *Rothii*, *Terminalia tomentosa*, *Tecoma undulata*, *Olea cuspidata*, *Ficus infectoria* and *palmata*, *Morus indica*, *Celtis australis*, *Alnus nitida*, *Populus euphratica*[2] and *nigra*, *Salix tetrasperma*. The only indigenous Palms are *Phoenix sylvestris* and *Nannorrhops Ritchieana*. The only Bamboo is *Dendrocalamus strictus*.

Of shrubs, among the most conspicuous are isolated clumps of the columnar, almost leafless *Euphorbia Royleana* and *neriifolia*. Other more or less prevalent shrubs and undershrubs in certain districts are *Capparis aphylla*, *horrida*, and *spinosa*, *Flacourtia Ramontchi*, *Tamarix dioica* and *gallica*, *Grewia* (seven species), *Fagonia arabica*, *Rhamnus persica* and *virgata*, *Zizyphus nummularia*, *vulgaris*, and *Oenoplia*, *Dodonaea viscosa*, *Alhagi maurorum*, *Sophora mollis*, *Cassia auriculata*, *Tora*, and *obovata*, *Mimosa rubicaulis*, *Pluchea lanceolata*, *Reptonia buxifolia*, *Carissa diffusa*, *Rhazya stricta*, *Nerium odorum*, *Orthanthera viminea*, *Periploca aphylla*, *Calotropis procera* and *gigantea*, *Withania coagulans*, *Adhatoda Vasica*, *Calligonum polygonoides*, *Pteropyrum Olivieri*, *Salsola foetida*, and species of *Kochia*, *Suaeda*, *Anabasis*, &c.

Of special interest as shrubs of this region are three species of Cotton (*Gossypium*), a genus unknown as native in any other part of India. These are *G. Stocksii* in Sind, *G. Wightianum* in the Arāvalli forests, and *G. herbaceum* (?) in the Ambāla District of the Punjab. Having regard, however, to the many centuries during which cotton has been a staple crop in India, it may be doubted whether these three may not be the descendants of as many cultivated plants. It is a remarkable fact that one of these (*G. Wightianum*), which is grown as

[1] For an excellent account of the Flora of Rājputāna, to which I am greatly indebted, see Sir George King, in the *Indian Forester*.

[2] In India this widely spread Central Asian tree is confined to the plain of this Province and elevations up to 10,000 feet in the Tibetan Himālayas, whence it extends over Central Asia.

an erect shrub in many parts of India, should in the Arāvallis assume a scandent habit quite foreign to the genus.

Of climbing plants in this Region, *Ephedra Alte*, *Cuscuta reflexa*, *Cassytha filiformis*, with species of *Convolvulaceae* and *Asclepiadeae*, are the most frequent. The herbaceous vegetation includes plants of all the Orders in the decad, with others of *Fumariaceae*, *Papaveraceae*, *Cruciferae*, *Resedaceae*, *Caryophylleae*, *Zygophylleae*, *Ficoideae*, *Cucurbitaceae*, *Plantagineae*, *Amarantaceae*, *Chenopodiaceae*, and *Polygoneae*. The European *Asphodelus fistulosus* is a pest in cornfields. The curious eastern Rosaceous plant *Neurada procumbens* is confined to this Region, and the widely spread *Frankenia pulverulenta* and *Herniaria hirsuta* advance very little to the east of it. The Persian *Seetzenia orientalis* is in India all but confined to Sind; and the only Orchid is the diminutive terrestrial *Zeuxine sulcata*, which is ubiquitous in the plains of India. Grasses abound, especially *Eragrostis cynosuroides*, *Cynodon Dactylon*, *Eleusine flagellifera*, *Aeluropus villosus*, the odorous *Andropogon muricatus*, *Irawancusa* and *Nardus*, and the inodorous *I. squarrosus*.

Ferns are exceedingly few in this Region; five are found rather commonly in the dry districts, namely, *Nephrodium molle*, *Adiantum caudatum*, *A. Capillus-Veneris*, and *Actinopteris radiata*, with, on Mount Abu only, *Nephrodium cicutarium*, *Cheilanthes farinosa*, *Botrychium virginianum*, and *Adiantum lunulatum*.

It is not possible within the limits of this Sketch to enumerate in detail the botanical features of the various districts of the Indus Plain Flora, or to discuss the distribution of its principal trees and shrubs, many of which are limited as to locality. Having, however, been kindly favoured by Mr. T. R. Drummond, F.L.S., with some observations on this subject made purposely for this Sketch, I shall summarize them here, before concluding with a brief notice of some peculiarities of the Salt Range, Sind, and Indus Delta Floras.

Mr. Drummond selects the following plants as characteristic of the Indus Plain throughout: *Peganum Harmala*, *Crotalaria Burhia*, *Dalbergia Sissoo*, *Aerua lanata*, *Asphodelus fistulosus*, and species of *Suaeda*, *Kochia*, *Cenchrus*, *Pennisetum*, *Apluda*, *Eleusine*, and *Saccharum*. In Sind and the South Punjab he cites species of *Maerua*, *Crataeva*, *Cleome*, *Wrightia*, *Acacia rupestris*, *Nerium*, *Pulicaria Wallichiana*, *Echinops*, *Anticharis*, *Cordia Rothii*, *Blepharis sindica*, species of *Ocimum* and *Arnebia hispidissima*, the last two covering a large area of sand and perfuming the air in spring. In the Indus valley proper

he gives the following as characteristic: *Capparis spinosa*, *Diplotaxis Griffithii*, *Malcolmia strigosa*, *Gymnosporia*, *Sageretia Brandrethiana*, *Pluchea arguta*, *Pulicaria glaucescens*, *Boucerosia Aucheriana*, *Arnebia Griffithii*, *Withania coagulans*, *Stachys parviflora*, *Otostegia limbata*, *Eremostachys*, *Olea cuspidata*, *Pennisetum dichotomum*, *Aeluropus villosus*, *Haloxylon*, *Salsola*, and *Nannorrhops Ritchieana*. To the eastern districts belong *Capparis spinosa*, *Anogeissus pendula*, *Euphorbia Royleana*, *Cordia Rothii*, *Dichrostachys cinerea*, *Sterculia urens*, *Moringa concanensis*, *Boswellia serrata*, and *Acacia leucophloea*.

Rāwalpindi, of which the principal hills are the Salt Range, occupies the NW. corner of the Indus Plain area. Glancing at the map, it might be supposed that its Flora was that of the outer hills of the Himālayas; but this is not so, for though typically Himālayan plants occur on the more elevated parts of the range, its predominating vegetation is Oriental and European. Of this the most conspicuous examples are the *Resedaceae*, many species of *Cruciferae*, and the remarkable Palm *Nannorrhops Ritchieana*, the north-eastern limit of which is the Salt Range, the south-western limit Sind and Baluchistān.

Sind occupies about one-third of the Indus Plain area. Its Flora is a very poor one, comprising perhaps not more than 500 recorded species; but it is a very noteworthy one, in that it comprises a much larger proportion of North African plants than does any other Indian area, and that a very considerable number of these have not been found anywhere to the eastward of Sind. Its Flora promises to offer a most interesting study when material for this shall be forthcoming, the absence or rarity of species of higher groups which are prevalent in the Punjab being as remarkable as the prevalence of some others. The indigenous Cotton (*Gossypium Stocksii*) and Palm (*Nannorrhops Ritchieana*), both mentioned already, are its two most notable plants.

The Indus Delta repeats the vegetation of the Sundarbans of Bengal, with a greatly reduced number of species, and the absence of the two Palms (*Nipa fruticans* and *Phoenix paludosa*), and of the genus *Calamus*. It has, however, species of *Avicennia*, *Sonneratia*, *Rhizophora*, *Ceriops*, *Aegiceras*, and *Scaevola*, the latter genus unknown in the Sundarbans, together with the stately grass, *Oryza coarctata*, which has been found nowhere except in these two deltas.

The Gangetic Plain Region.

The Gangetic Plain Region presents three assemblages of plants which may be regarded as botanical Sub-regions: I. The dry upper valley from Eastern Rājputāna to the Kosi river;

that is, to a little above the bend of the Ganges at Rājmahāl; II. Bengal proper of the old maps, defined[1] as 'the humid region of the Gangetic delta and the region immediately north of it.' This Sub-region includes the Assam plain and a coast strip of Orissa, as far as the Mahānadī river. III. The Sundarbans.

The number of indigenous species in this Region is small, possibly amounting to 1,500, under 112 Orders, of which the following ten are dominant; the attached numbers in brackets are those of the corresponding decad in the Indus Plain Region:—

1. *Gramineae* (1).	6. *Malvaceae* (8).
2. *Leguminosae* (2).	7. *Acanthaceae*.
3. *Cyperaceae* (4).	8. *Euphorbiaceae* (9).
4. *Compositae* (3).	9. *Convolvulaceae* (10).
5. *Scrophularineae* (5).	10. *Labiatae* (6).

The only other Orders rich in genera and species are *Cucurbitaceae*, *Asclepiadeae*, *Verbenaceae*, and *Amarantaceae*. The largest genera are *Hibiscus*, *Indigofera*, *Crotalaria*, *Ipomoea*, *Polygonum*, *Cyperus*, *Fimbristylis*, *Panicum*, *Andropogon*, and *Eragrostis*; *Gymnospermae* and *Cupuliferae* are absent; and the European Orders *Ranunculaceae*, *Cruciferae*, *Caryophylleae*, *Geraniaceae*, *Rosaceae*, *Saxifragaceae*, *Campanulaceae*, and *Gentianeae* are very scantily represented, chiefly by annual weeds.

The Upper Gangetic Plain.

The indigenous vegetation of the upper part of this Sub-region is that of a dry country, the trees in the dry season being leafless (for the most part) and the grasses and other herbs burnt up; but by far the greater part of the land to the eastward contrasts with that to the westward in being under cultivation. In the extreme west, the Flora is continuous with that of the Indus Plain, and might perhaps be better included in that Region, *Peganum Harmala*, *Pluchea lanceolata*, *Tecoma undulata*, and other plants characteristic of the Punjab being equally so of the western part of this Sub-region. These gradually disappear in following the course of the Ganges downwards into a more humid climate, and towards the entrance of the Kosi river they are replaced by

[1] This is the definition of Bengal adopted in Yule and Burnell's *Anglo-Indian Glossary*. Politically, Bengal includes Sikkim on the north, Orissa, Bihār, and Chotā Nāgpur on the south and west, and Chittagong and Tippera on the east. Of this political Province (excluding Sikkim), a Flora by Major Prain has just been published.

the plants typical of Bengal proper. The principal forest is that of Ajmer, flanking the Arāvalli and other hills which bound the Sub-region on the west. The most characteristic tree of this forest is *Anogeissus pendula*; others more or less restricted to Western India are *Boswellia serrata*, *Balsamodendron Mukul* (which is rare), *Moringa pterygosperma*, *Rhus mysorensis*, *Acacia Senegal*, and *Prosopis spicigera*, accompanied by the common trees of the drier parts of India, especially *Butea frondosa*. The Bengal rose (*Rosa involucrata*) occurs frequently, forming an erect bush in the open, and seeming to an English eye to be quite out of place in its climate and its surroundings. Several British herbaceous plants are common, flowering in the cool season, especially *Ranunculus sceleratus*, *Malva rotundifolia*, *Lathyrus Aphaca*, *Anagallis arvensis*, and *Veronica agrestis*. *Dendrocalamus strictus* and *Bambusa Balcooa* are the only indigenous Bamboos, being natives of the bordering hills rather than of the plain. The cultivated *Phoenix* and *Borassus* are the two Palms most commonly seen, but two species of Rattan (*Calamus*) are found in thickets. Considerable areas of this Sub-region are occupied by the Usar, or Reh-lands, which, being impregnated with alkalies, and converted into swamps in the rainy season and into deserts in the dry, are as unfavourable to a native as they are to an introduced vegetation. *Salvadora persica* is said to be the only tree that will succeed on the most saline of them, and of herbaceous plants a few perennial-rooted grasses are the only ones which thrive.

Bengal Proper.

Bengal proper, by its humidity and luxuriant evergreen vegetation, contrasts favourably with the upper valley of the Ganges. The villages are usually buried in groves of Mango, Figs, and Bamboos, with the Betel-nut Palm, Palmyra, Phoenix, and Coco-nut. The trees are of many kinds, and it is difficult to distinguish the indigenous from the introduced. Except perhaps a few *Fici*, the most common belong to the latter class. Such are *Michelia Champaca*, *Polyalthia longifolia*, *Bombax malabaricum*, *Eriodendron anfractuosum*, *Lagerstroemia Flos-reginae*, *Pterospermum acerifolium*, with species of *Terminalia* and *Artocarpus*. The shrubby and herbaceous vegetations are for the most part of species found all over India. In the *Jhīl* district in the east, where the waters of the great rivers Ganges, Brahmaputra, and Surmā inosculate and overflow during the rains, aquatic and marsh plants, especially *Cyperaceae* and tall *Gramineae* of many kinds, prevail, but not the *Nymphaeaceae* (*Nymphaea*, *Nelumbium*, and

Euryale), which affect stiller and shallower waters. The most interesting of the water-plants of India is *Aldrovanda vesiculosa*, the curious floating Fly-trap mentioned at p. 161. There are few Orchids, and those are mostly terrestrial. The epiphytic Orchids include species of *Vanda*, *Luisia*, and *Cymbidium*. *Aroideae* abound, and are conspicuous features both wild and in cultivation; among the latter are broad-leaved species of *Amorphophallus*, *Alocasia*, and *Colocasia*; of the wild the most conspicuous are *Scindapsus officinalis*, clothing the trunks of trees with its magnificent foliage, and *Pothos scandens*, which simulates the Ivy in covering walls and tree trunks. The prickly *Lasia heterophylla* abounds in the marshes, and species of the curious genus *Cryptocoryne*, with twisted spathes, are frequent on the river margins. *Pistia Stratiotes* is ubiquitous in fresh water, and several species of *Lemna* are common. An anomalous feature in the Flora of Bengal is the occurrence on rising grounds between the *Jhīls* of a few plants typical of the Khāsi Hills. Of this the District of Mymensingh affords an example, in which may be found, together with the common plants of Bengal, a few wanderers from the hilly regions to the northward.

The Sundarbans.

The estuarial Floras[1] of India are notable, inasmuch as that, considering the limited areas they occupy, they contain more local species than do any other botanical regions in India. This is due to the saline properties of their waters, and to tidal action on the land. The islets of the Sundarbans are in great part clothed with a dense evergreen forest of trees and shrubs, amongst which the various Mangroves hold the first place, with an undergrowth of climbers and herbaceous plants, together with *Typhaceae*, *Gramineae*, and *Cyperaceae*. Two gregarious Palms form conspicuous features, the stemless *Nipa fruticans* in the swamps and river banks, with leaves thirty feet long, and the elegant *Phoenix paludosa* in drier localities; as also do the cultivated Coco-nut and Betel-nut Palms. The principal exceptions to these forest-clad tracts are the sand hills occurring at intervals along the coasts facing the sea, the vegetation of which differs from that of the inland muddy islets and grassy savannahs which become more frequent in advancing eastward towards the mouth of the Meghnā.

[1] The four chief estuarial Floras of India occupy the deltas of the Ganges, Irrawaddy, Mahānadī, and Indus; but minor ones, notably those of the Kistna and Cauvery, occur at intervals commonly along the eastern shores, more rarely on the western.

Three hundred indigenous species of Flowering plants, under seventy-two Orders, and seventeen Ferns and their allies are comprised in the Sundarbans Flora.[1] Of these the dominant Orders are:—

1. *Leguminosae.*
2. *Gramineae.*
3. *Cyperaceae.*
4. *Euphorbiaceae.*
5. *Orchideae.*
6. *Compositae.*
7. *Asclepiadeae.*
8. *Verbenaceae.*
9. *Convolvulaceae.*
10. *Malvaceae.* / *Rubiaceae.* / *Acanthaceae.* / *Urticaceae.*

A very large proportion of genera consist of a solitary species. Of the trees and shrubs one alone, *Ficus*, contains four. There are about fifty species of trees which may be classed according to whether they are purely estuarial, or common to other parts of India. Among the former are *Hibiscus tortuosus*, *Thespesia populnea*, *Brownlowia lanceolata*, *Amoora cucullata*, *Carapa moluccensis* and *obovata*, *Bouea burmanica*, *Erythrina indica*, *Afzelia bijuga*, *Rhizophora conjugata* and *mucronata*, *Ceriops Roxburghiana*, *Kandelia Rheedei*, *Bruguiera gymnorhiza* and *parviflora*, *Lumnitzera racemosa*, *Barringtonia racemosa*, *Sonneratia apetala* and *acida*, *Aegialitis rotundifolia*, *Aegiceras majus*, *Cerbera Odollam*, *Avicennia officinalis* and *alba*, *Excaecaria Agallocha*, *Sapium indicum*, *Casuarina equisetifolia* (doubtfully indigenous), *Nipa fruticans*, and *Phoenix paludosa*; to which may be added, as estuarial woody climbers, *Hibiscus tiliaceus*, *Dalbergia spinosa* and *torta*, *Mucuna gigantea*, *Derris sinuata* and *uliginosa*, *Finlaysonia obovata*, and *Sarcolobus globosus*; and among under-shrubs *Acanthus ilicifolius* and *volubilis*. Of trees common to inland Bengal there are about as many as there are purely estuarial; they include *Kleinhovia Hospita*, *Micromelum pubescens*, *Aegle Marmelos*, *Zizyphus Jujuba*, *Odina Wodier*, *Cassia Fistula*, *Pongamia glabra*, *Acacia tomentosa* and *arabica*, *Barringtonia acutangula*, *Ixora parviflora*, *Morinda bracteata*, *Diospyros montana* and *Embryopteris*, *Cordia Myxa*, *Dolichandrone Rheedii*, *Vitex trifolia* and *Negundo*, *Cyclostemon assamicus*, *Croton oblongifolius*, *Antidesma Ghaesembilla*, *Trewia nudiflora*, *Streblus asper*, *Trema orientalis*, and four species of *Ficus*.

[1] These numbers are taken from Major Prain's exhaustive article entitled 'Flora of the Sundribuns,' published in the *Records of the Botanical Survey of India*, vol. ii, p. 231 (June, 1903), upon which I have drawn largely in the following Sketch.

Of herbaceous plants that are purely estuarial there are few, the most remarkable of them being two tall grasses: one, *Oryza coarctata*, which grows profusely on the banks of the islets, but (except in the delta of the Indus) has been found nowhere else; the other, *Myriostachya Wightiana*, is also a native of estuaries on the eastern side of the Bay of Bengal and of Ceylon.

Of aquatic plants with floating leaves *Nymphaeaceae* are entirely absent, as are *Lemnaceae*; but *Limnanthemum cristatum* is found, and in the salt-pans on the northern limits of this Subregion *Aldrovanda vesiculosa*, mentioned above (pp. 161, 182). There are also a few species of *Utricularia*, *Ipomoea aquatica*, and the common *Naiadaceae* and *Hydrocharideae* of India. *Pistia* abounds in tanks and the fresher-water districts. The Sundarbans Orchids comprise eight genera and thirteen species, all epiphytic. A species of *Cirrhopetalum* alone is endemic. Of parasites there are four species of *Loranthaceae*, a *Cuscuta*, and *Cassytha*. *Bambuseae* are entirely absent. The indigenous Palms are the above-mentioned *Nipa* and *Phoenix*, and two Rattans (a *Calamus* and a *Daemonorops*), both the latter common to Bengal.

Major Prain, in his 'Flora of the Sundribuns' (see footnote, p. 183), enumerates thirty-five littoral flowering plants, under twenty-one Orders, which, though widely distributed on other shores of India, have not been detected in this Region; among the most common of these are *Calophyllum inophyllum*, *Heritiera littoralis*, *Suriana maritima*, *Sophora tomentosa*, *Lumnitzera coccinea*, *Pemphis acidula*, *Scaevola Koenigii*, *Pisonia* (three species), *Euphorbia Atoto*, *Lepturus repens*, and *Spinifex squarrosus*.

A most remarkable character of the estuarian vegetation is the habit of several of the endemic species to send up from their subterranean roots a multitude of aerial root-suckers, in some cases several feet long, which act as respiratory organs. These suckers occur in species of *Avicennia*, *Carapa*, *Heritiera*, *Amoora*, *Sonneratia*, and in *Phoenix paludosa*.

The Western Peninsula (the Deccan and Malabar Regions).

The Flora of the large portion of India, roughly bounded on the north by the Vindhya, Kaimur, and Rājmahāl Hills, and extending south to Cape Comorin, comprises two very distinct botanical Regions, a comparatively narrow western and a broad eastern; but materials do not exist for drawing the phytographical boundary line between them with any approach to accuracy. This is due to the fact that the western Region (Malabar), which is mountainous throughout (and technically

called the Western Ghāts), sends, for a great part of its length, spurs across the more depressed eastern Region, carrying with them characteristic western plants. Furthermore, no complete local Flora has been published for any considerable area of the Peninsula, and over many parts no collections have been made; not even a list of the plants around the city of Madras has been published, and only a very imperfect one of the Bombay Presidency[1]. Before, therefore, proceeding to describe the two Regions of Malabar and the Deccan, I shall, regarding them as one, contrast it with that of the Botanical Regions on the eastern side of the Bay of Bengal (Burma).

Upwards of 4,000 species of Flowering plants have been recorded from the whole Western Peninsula as above delimited, under about 150 Natural Orders, of which the ten dominant are here given in approximately numerical sequence, the figures in brackets indicating their corresponding position in the Burmese decad:—

1. *Gramineae* (3)
2. *Leguminosae* (2).
3. *Acanthaceae* (6).
4. *Orchideae* (1).
5. *Cyperaceae* (7).
6. *Euphorbiaceae* (5).
7. *Rubiaceae* (4).
8. *Compositae* (9).
9. *Labiatae*.
10. *Asclepiadeae*[2].

The proportion of Monocotyledons to Dicotyledons is about 1 to 2·7, and of genera to species 1 to 3·3.

Indicating the Western Peninsula and Burma with the Malay Peninsula respectively by the letters W. and E., the vast difference between the Floras of the two great areas south of the Himālayas is made manifest by the following comparison of the approximate number[3] of species contained in twenty-seven Natural Orders common to both.

[1] Dalzell and Gibson's *Bombay Flora* (1861). A complete Flora of the Bombay Presidency is now being prepared by Dr. T. Cooke, C.I.E., F.L.S., of which one volume (*Ranunculaceae* to *Rubiaceae*) and a part of a second have been published.

[2] The inclusion of *Asclepiadeae* in this decad, and the absence from it of *Scrophularineae*, are notable. Referring to the *Flora of British India*, I find about eighty species of the one and sixty-five of the other recorded as indigenous in the Western Peninsula. On the other hand, in a list of 1,377 Flowering plants collected in Chotā Nāgpur, I find thirty-eight *Scrophularineae* and only fifteen *Asclepiadeae* (J. J. Wood in *Records of Botanical Survey of India*, vol. ii, p. 1).

[3] The numbers given are approximations only. The inclusion of Ceylon in the Western Region would only slightly modify them.

Orders in excess in the East :—

Dilleniaceae	W. 5/E. 14,	*Magnoliaceae*	W. 3/E. 8,	*Anonaceae*	W. 34/E. 260,
Guttiferae	W. 13/E. 53,	*Ternstroemiaceae*	W. 3/E. 24,	*Dipterocarpeae*	W. 12/E. 74,
Burseraceae	W. 9/E. 33,	*Olacineae*	W. 19/E. 42,	*Sapindaceae*	W. 40/E. 46,
Anacardiaceae	W. 24/E. 66,	*Connaraceae*	W. 4/E. 28,	*Myrtaceae*	W. 35/E. 102,
Melastomaceae	W. 36/E. 123,	*Gesneraceae*	W. 12/E. 70,	*Myristicaceae*	W. 5/E. 47,
Urticaceae	W. 74/E. 114,	*Palmeae*	W. 23/E. 128,	*Aroideae*	W. 40/E. 170,
Bambuseae	W. 17/E. 30,	*Coniferae*	W. 1/E. 9		

Orders in excess in the West :—

Capparideae	W. 30/E. 15,	*Umbelliferae*	W. 33/E. 3	*Commelinaceae*	W. 52/E. 11,
Acanthaceae	W. 207/E. 34,	*Labiatae*	W. 127/E. 10,	*Boragineae*	W. 161/E. 8,
Gramineae	W. 377/E. 98.				

Furthermore, the estuarial Palms *Nipa* and *Phoenix paludosa* are unknown on the west side south of Orissa, as are *Cupuliferae*, of which upwards of forty species are found in the Eastern Region.

Malabar Region.

Malabar is almost throughout a hilly or mountainous country, and is (except in the north) of excessive humidity, the mountains often rising abruptly from the flat coast of the Arabian Sea. The average breadth of the Region may be about 50 miles. Its abrupt western face is clothed with a luxuriant forest vegetation of Malayan type, except towards the north, where, with the drier climate, the elements of the Deccan and Indus Plain Floras compete with that of Malabar. The eastern face slopes gradually into the elevated plateau of the Deccan, but it is varied by many spurs being thrown off which extend far to the eastward, often, as above stated, enclosing valleys with a Malabar Flora. One great break occurs in the chain in lat. 11° N., where a transverse valley separates Travancore from the mountains north of it, and carries species characteristic of the Malabar Flora almost across the Peninsula. Travancore, thus isolated, presents a remarkable similarity to Ceylon in position, outline, and in many features of its vegetation. The most distinctive characters of the Malabar Flora, in contrast with that of the Deccan, are: firstly, the presence of *Guttiferae* (thirteen), *Dipterocarpeae* (twelve), *Myristiceae*, a *Helicia*, many Palms (twenty-one), and *Bambuseae*; secondly, the great excess of species of Malayan type, especially *Sterculiaceae*, *Tiliaceae*, *Anacardiaceae*, *Meliaceae*, *Myrtaceae*,

Melastomaceae, *Ampelideae*, *Gesneraceae*, *Piperaceae*, *Scitamineae*, *Orchideae*, and *Aroideae*. One Coniferous plant alone has been found in the whole Deccan Peninsula, *Podocarpus latifolia*, confined to the Tinnevelly Ghāts at 3,000 to 5,000 feet elevation. Burma and the Malayan Peninsula are the only other Regions in which it occurs. Of the Palms, one genus is all but endemic, *Bentinckia Coddapanna*, a native of Travancore, the only congener of which is confined to the Nicobar Islands. The only species of *Pinanga* (*P. Dicksonii*) is endemic, as are nine species of *Calamus*. Other Palms are solitary species of *Arenga*, *Caryota*, *Corypha*, with the cultivated *Areca Catechu*, *Borassus*, and Coco-nut, which latter may be indigenous on the coast, as it is said to be in the Laccadive Islands. *Phoenix sylvestris*, doubtfully indigenous, is common in the north but rare in the south; and there are several indigenous species of the genus in the hills which have not been botanically distinguished, one especially that grows gregariously in the Ghāts 40 miles west of Poona, with a trunk 30 feet high and 15 inches in diameter. Among shrubs, the genus *Strobilanthes* with forty-six species holds the first place, distinguished for the beauty of their flowers and for the singular habit (alluded to at p. 160) of many of its species flowering simultaneously for the first and only time, at a fixed period of growth, and dying after fruiting. Of *Bambuseae* there are seventeen species, arboreous and shrubby, five of them also natives of Ceylon. Among herbaceous plants the genus *Impatiens* with about sixty endemic species is the most conspicuous, almost carpeting the ground in many places, in others occurring epiphytically, which is not known to be the case with this huge genus in any other part of India. Of Orchids there are only about 200, a singular contrast to the hosts of this Order inhabiting Burma and the Malayan Peninsula. Most of the genera are epiphytic, and of these the largest is *Dendrobium*, with sixteen species. *Habenaria*, with about forty-six species, is the largest by far of terrestrial genera. *Umbelliferae* occur throughout the range of the Western Ghāts, increasing in numbers northwards; eleven genera with thirty species have been recorded. Several genera of the curious aquatic Order *Podostemonaceae*, mentioned at p. 161, abound in the fresh-water torrents and in stiller waters of the Ghāts.

The Nīlgiri Hills form a nœud of the Western Ghāts, where these attain their greatest elevation, viz. 8,760 feet. They rise precipitously from the west to extensive grassy downs and table-lands seamed with densely wooded gorges (Sholas). The Nīlgiris.

These grassy downs possess in parts a rich shrubby and herbaceous Flora. Among the shrubs, some of the most characteristic are *Strobilanthes Kunthianus*, *Berberis aristata*, *Hypericum mysorense*, many *Leguminosae*, as the common Gorse (introduced), *Sophora glauca* and *Crotalaria formosa*, *Rhododendron arboreum*, species of *Rubus*, *Osbeckia*, *Myrtaceae*, *Hedyotis*, *Helichrysum*, *Gaultheria*. Among the herbaceous plants are species of *Senecio*, *Anaphalis*, *Ceropegia*, *Pedicularis*, and *Cyanotis*. Most conspicuous of all is the tall *Lobelia excelsa*.

But the richest assemblage is found in the Sholas, which, commencing at about 5,000 feet, ascend to the summits of the range. They are filled with an evergreen forest of tall, usually round-headed trees, with a rich undergrowth. Of the trees, some of the most conspicuous are *Michelia nilagirica*, *Ternstroemia japonica*, *Gordonia obtusa*, species of *Ilex*, *Meliosma*, *Microtropis*, *Euonymus*, *Photinia*, *Viburnum hebanthum*, *Eugenia* (three species), and several of *Symplocos*, *Glochidion*, *Araliaceae*, and *Laurineae*. Of shrubs, *Strobilanthes* takes the first place, then *Rubiaceae*, with species of *Eurya*, *Ligustrum*, and *Vernonia*. Of climbers, there are *Rosa Leschenaultiana*, *Jasminum brevilobum*, *Gardneria ovata*, *Gymnema hirsutum*, and *Elaeagnus latifolia*. The genus *Impatiens* takes the lead among conspicuous herbaceous plants, and the beautiful *Lilium neilgherrense* is a notable feature. At lower elevations in the Sholas, *Hydnocarpus alpina* is a very common tree, and in dry localities *Rhododendron arboreum* and *Vaccinium Leschenaultii*. Two species of Bamboo are found in the Sholas, namely, *Arundinaria Wightiana* in the higher parts, and *Oxytenanthera Thwaitesii* (also a native of Ceylon) in the lower, where also three Tree-ferns appear, with many Orchids and several species of *Calamus*, all evidences of a higher temperature.

Sholas similar to those of the Nīlgiris occur on the Anaimalai, Palni, and other ranges of the Malabar Ghāts; but these, being of a lower elevation, and in a lower latitude, harbour a more tropical vegetation.

The most interesting feature of the Nīlgiri Flora is its affinity with that of the cool regions of the far-distant Khāsi, Manipur, and Nāgā Hills in Northern Burma. Among trees and shrubs common to these two localities (and most of them to the temperate Eastern Himālayas also), are *Ternstroemia japonica*, *Hypericum Hookerianum* and *napaulense*, *Eurya japonica*, *Rhamnus dahuricus*, *Photinia Notoniana*, *Rubus ellipticus* and *lasiocarpus*, *Carallia integerrima*, *Rhododendron arboreum*,

Gaultheria fragrantissima, and *Gardneria ovata*, together with species of *Kadsura*, *Berberis*, *Pittosporum*, *Elaeocarpus*, *Euonymus*, *Meliosma*, *Pygeum*, *Rosa*, *Viburnum*, *Lonicera*, *Vaccinium*. The herbaceous plants common to the Nīlgiri and Khāsi Hills are too numerous to mention. Most of them are of European genera, and some are European species, as *Stellaria uliginosa*, *Circaea alpina*, *Sanicula europaea*, and *Prunella vulgaris*. Other herbaceous European genera are *Thalictrum*, *Ranunculus*, *Cardamine*, *Geranium*, *Alchemilla*, *Fragaria*, *Potentilla*, *Parnassia*, *Lysimachia*, *Swertia*, *Halenia*, *Gentiana*, *Calamintha*, *Scutellaria*, *Ajuga*, &c., with many of *Cyperaceae* and grasses.

Peat bogs[1], which are of the rarest occurrence in India, are found in depressions of the Nīlgiri and Anaimalai Hills at about 7,000 feet elevation. Their chief constituents are the débris of grasses, sedges, mosses, and rushes. The curious *Hedyotis verticillata*, found elsewhere only in Ceylon, is characteristic of these bogs, whose surface is covered with a herbaceous vegetation of species of *Utricularia*, *Scrophularineae*, *Eriocaulon*, *Xyris*, *Exacum*, *Commelinaceae*, *Lysimachia*, &c.

The Nīlgiri Hills have been largely and successfully planted with exotic trees of temperate climates, among which the Australian gum-trees and acacias are the most conspicuous.

The Laccadive Archipelago.

The Laccadive Archipelago[2], situated in the Arabian Sea 140 miles from the coast of Malabar, consists of coral islets fringed with Coco-nut Palms. Its vegetation is Malayan, with no endemic species. The trees have mostly been introduced by man, as *Areca Catechu*, *Artocarpus integrifolia*, *Morinda citrifolia*, *Terminalia Catappa*, *Eugenia Jambos*; others, all littoral, are probably the result of ocean-borne seeds, as *Pandanus fascicularis*, *Hernandia peltata*, *Pisonia alba*, *Ochrosia borbonica*, *Guettarda speciosa*, *Thespesia populnea*. The herbaceous plants are chiefly the weeds of the Western Peninsula. The littoral grass *Spinifex*, mentioned at p. 193, was probably bird- or wind-borne.

The Deccan Region.

Regarding the whole Peninsula south of the Ganges Valley and east of the Malabar Ghāts as one botanical Region,

[1] I am indebted to Mr. Gamble, C.I.E., F.R.S., for an account of the Nīlgiri peat bogs, which are the only ones in India of which the produce is utilized for fuel. I am also largely indebted to the same excellent botanist in respect of the Shola Flora.

[2] The Flora of the Laccadives has been exhaustively explored and described by Major Prain in the *Journal of the Bombay Natural History Society*, vol. viii (1892), where 190 species of Flowering plants are recorded.

it is primarily divisible into two Sub-regions: one, the elevated, usually hilly, sometimes mountainous, plateau terminating eastward more or less abruptly at no great distance from the sea in what are called the Eastern Ghāts, from which the descent is more or less sudden to the low coast land of Coromandel, which forms the other Sub-region. The great plateau may prove to be further transversely divisible into Sub-regions, but so little is accurately known of the distribution of plants over the Deccan that neither the limits nor the botanical characters of such can be satisfactorily described. Such may be—

1. The region bounded on the south by the Ajanta hills and Godāvari river, exclusive of the plains of North-east Orissa which belong to the Bengal Sub-region. It thus includes the upper valleys of the Narbadā, Tāpti, Mahānadī, and Godāvari rivers, belonging for the greater part to the political Provinces of Bombay, Central India, the Central Provinces, Berār, Chotā Nāgpur, and Orissa. It is hilly and even mountainous almost throughout, rising in scattered isolated peaks or table-lands to above 4,000 feet, of which the two loftiest are Parasnāth in Hazāribāgh (4,490 feet), and Mahendragiri (4,923 feet) in Ganjām near the sea.

This hilly and mountainous country is for by far the greater part botanically unexplored. It is in the main covered with deciduous-leaved forests, the type of which may be inferred from the following list of forest trees of Singhbhūm in Chotā Nāgpur, drawn up for this Sketch by Mr. H. H. Haines, F.L.S., of the Forest Department.

Singhbhūm is in the zone of deciduous-leaved forest, and lies in the 'Central Indian Sāl tract.' With a high temperature in the shade and mountains rising to 3,000 feet with scorched southern slopes and deep damp valleys, its Flora contains representatives of dry hot countries with plants characteristic of the moist tracts of Assam, of some of which latter a list follows this. On rocks often too hot to be touched with the hand are found *Euphorbia Nivulia*, *Sarcostemma*, *Sterculia urens*, *Boswellia serrata*, and *Cochlospermum*. The ordinary mixed forest of dry slopes is composed of *Anogeissus latifolia*, *Ougeinia*, *Odina*, *Cleistanthus collinus*, *Zizyphus xylopyra*, *Buchanania latifolia*, and species of *Terminalia* and *Bauhinia*. The Sāl varies from a scrubby tree of 30 feet to one of 120 feet high, and is often associated with *Adina*, *Bassia latifolia*, *Diospyros*, *Symplocos racemosa*, *Pterocarpus Marsupium*, *Eugenia Jambolana*, and especially *Wendlandia tinctoria*. Its common associates elsewhere, *Careya arborea* and *Dillenia*

pentagyna, are here confined to the valleys; but *Dillenia aurea*, a tree of the Eastern Peninsula and tropical Himālayas, is, curiously, common in places. The Flora of the valleys includes *Garcinia Cowa*, *Amoora Rohituka*, *Hardwickia binata*, *Saraca indica*, *Ficus Roxburghii*, *Gnetum scandens*, *Musa sapientum* and *ornata*, and others less interesting. The best-represented woody Orders are the *Leguminosae*, *Rubiaceae* (including six species of *Gardenia* and *Randia*), *Euphorbiaceae*, and the *Urticaceae* (mostly Figs). Of other Orders the grasses number between one and two hundred species, including the Sabai grass (*Ischaemum angustifolium*) and Spear-grass (*Andropogon contortus*), which are most abundant; the *Cyperaceae* about fifty, *Compositae* fifty, and the *Acanthaceae* about eleven under-shrubs and twenty-five herbs.

The Flora, though mainly that of other parts of the Deccan, presents a few types of the Eastern and Western Himālayas, both tropical and temperate, as epiphytic Orchids, species of *Thalictrum* and *Berberis*; and what is more singular, in Chotā Nāgpur a few plants elsewhere confined to the humid districts of Assam and Burma[1], as *Michelia Champaca*, *Dillenia aurea*, *Dysoxylum procerum*, *Pygeum acuminatum*, *Lasianthus laurifolius*, *Dysophylla Andersoni*, *Lysimachia peduncularis*, *Ardisia depressa*, *Beilschmiedia fagifolia*, *Litsea nitida*, *Cyclostemon assamicus*, and Tree-ferns.

2. The Deccan, in a restricted sense the country between the Godāvari and Kistna rivers, a much less mountainous region, including Hyderābād.

3. Mysore, roughly limited by the Kistna river on the north, and the lower course of the Cauvery on the south. It is more hilly than the Deccan proper, and even mountainous in the Salem District, where the botanically unexplored Shevaroy and Kalrāyan hills attain 5,000 feet elevation.

4. The small Districts of Madura and Tinnevelly, which form a prolongation of the Coromandel coast terminating at Cape Comorin.

The Deccan.

Over the Deccan Region deciduous forests are the most conspicuous feature on the plateau, and comparatively evergreen ones on the coasts and slopes with an eastern aspect. The Teak occurs at intervals nearly over the whole area, but the Sāl, which is common in the north, does not advance beyond the Godāvari on the south, or west of long. 78° E. Much of the open country presents a jungle of small trees

[1] For a list of which recent discoveries I am indebted to Major Prain, F.L.S., of the Royal Botanic Gardens, Calcutta.

and shrubs, together with a herbaceous vegetation which is leafless or burnt up in the dry season. In the large river valleys and those of the higher hills, types of the Malabar Flora penetrate far to the east. Of forest trees there are several hundred species, among which *Sterculiaceae*, *Meliaceae*, *Anacardiaceae*, *Leguminosae*, *Combretaceae*, *Rubiaceae*, *Bignoniaceae*, *Euphorbiaceae*, and *Urticaceae* are well represented. The Satin-wood (*Chloroxylon Swietenia*) and Indian Red-wood (*Pterocarpus santalinus*) yield the most ornamental Indian timbers; the Tūn (*Cedrela Toona*) one of the most useful. The odoriferous Sandal-wood (*Santalum album*) is widely distributed over the southern part of the area, as are the small trees *Cochlospermum Gossypium*, *Butea frondosa*, and some species of *Bauhinia*, all conspicuous in the dry season for their beautiful flowers. Of shrubs, species of *Capparis*, *Grewia*, *Flacourtia*, *Zizyphus*, *Buchanania*, *Holarrhena*, *Lagerstroemia*, *Woodfordia*, *Azima*, *Diospyros*, *Flueggia*, and *Phyllanthus* are very prevalent, often overgrown with climbing *Menispermaceae*, *Malpighiaceae*, *Toddalia*, *Cuscuta*, *Cassytha*, *Smilax*, *Dioscorea*, *Asclepiadeae*, *Apocyneae*, *Ampelideae*, and *Convolvulaceae*. In rocky places the columnar *Euphorbia neriifolia* and *tortilis* are conspicuous features. The herbaceous vegetation of the Deccan includes most of the common annuals and perennials of Bengal, among which *Acanthaceae* are notable. *Commelinaceae* and species of the Labiate genus *Leucas* are more abundant than in any other Indian Region. Except in the northern districts, *Orchideae* and *Scitamineae* are very rare. Of Palms there are *Calamus viminalis*, *Phoenix sylvestris*, *P. robusta*, and *Borassus flabellifer*, the three latter growing gregariously; and there are besides *P. acaulis* and *P. humilis*, both in the northern tract, and an undetermined species grows gregariously in the Shevaroy Hills near Salem. The chief Bamboos are *Bambusa arundinacea* and *Dendrocalamus strictus*. Ferns and their allies are very rare, except in the north, where forty-seven species are recorded from Chotā Nāgpur.

The rich black cotton soil that prevails over large areas in the Deccan deserves a special notice, as being characterized by a peculiar assemblage of the indigenous plants of the Region. I am indebted to Mr. Gamble for the following list of its common trees: *Capparis divaricata*, *Acacia arabica*, *Prosopis spicigera*, *Parkinsonia aculeata*, and *Balanites Roxburghii*; of shrubs, *Cadaba indica*, *Zizyphus nummularia*, *Cassia auriculata*, *Calotropis procera*, and *Jatropha glandulifera*; and of

herbs, *Hibiscus Trionum*, *Momordica cymbalaria*, and *Cressa cretica*.

Coromandel Sub-region.

The narrow strip of low-lying land between the Eastern Ghāts of the Deccan and the sea is dry, hot, and, in many tracts, sandy. Except at the mouths of the many rivers, where Mangroves and other common estuarial trees and shrubs prevail, there is little to break the uniformity of the vegetation, which is of the Deccan type, with a greatly reduced number of species. Thickets of thorny evergreens and deciduous trees and shrubs abound, belonging to the genera *Flacourtia*, *Randia*, *Scutia*, *Diospyros*, *Mimusops*, *Garcinia*, *Sapindus*, *Pterospermum*, &c. It is well known for being a favoured district for the production of Nux vomica, Satinwood, and Ebony (*Diospyros Ebenum*[1]). Two very peculiar gregarious plants, a Palm and a grass, form impenetrable spinous thickets in sandy soils near the sea; these are *Phoenix farinifera* and *Spinifex squarrosus*, of which latter great globular masses become uprooted and are carried by the wind along the shore.

In the extreme south the Districts of Madura and Tinnevelly, being sheltered from the monsoon by the Palni Hills on the north and Ceylon on the east, are exceptionally hot and arid. The umbrella-shaped *Acacia planifrons* is confined to these Districts and to North Ceylon, regions which resemble Egypt in the prevalence of *Cocculus Leaeba* and *Capparis aphylla*, and in the production of the finest Cotton and the best Indian Sennas (*Cassia obovata* and *angustifolia*).

The Ceylon Region.

Ceylon, though so near in position to the Western Peninsula, and presenting so close an affinity to its Flora, as also to those of both Malabar and the Deccan, nevertheless contains so large a proportion of endemic genera and species that it constitutes a separate Region of the Indian Flora. Its botanical features coincide with its physical, the moist mountainous southern and south-western districts having a Flora of the Malabar type, and the hot dry northern districts one of the Coromandel type. It differs from the Malabar Flora in having many more Malayan types.

The number of indigenous Flowering plants in Ceylon is about 2,800 species, under 149 Natural Orders, and that of Ferns and their allies 257 species. Of these 2,800 species no fewer than one-third (940) are non-peninsular, of which again 160 are natives of other parts of India, the majority of them being

[1] *D. Ebenum* is also a native of Ceylon.

Burmese or Malayan, leaving 780 endemic Ceylon species. The following are the ten dominant Orders of Ceylon Flowering plants, with their corresponding position in the Peninsular decad added in brackets :—

1. *Gramineae* (1).
2. *Leguminosae* (2).
3. *Orchideae* (4).
4. *Cyperaceae* (5).
5. *Rubiaceae* (7).
6. *Euphorbiaceae* (6).
7. *Acanthaceae* (3).
8. *Compositae* (8).
9. *Urticaceae*.
10. *Melastomaceae*.

The proportion of Monocotyledons to Dicotyledons is nearly 1 to 3·6, and of genera to species about 1 to 2·6. Comparing the above decad with the Western Peninsular (p. 185), it is seen that *Orchideae* and *Rubiaceae* are more numerous in Ceylon, *Acanthaceae* much fewer; and that *Urticaceae* and *Melastomaceae* replace *Labiatae* and *Asclepiadeae*. These changes all point to the stronger Malayan affinity of the Ceylon Flora, which is further demonstrated by the following figures, where the letter C. indicates Ceylon, and P. the Western Peninsula :—

Malayan affinity strongest in Ceylon—

Dilleniaceae	$\frac{\text{C. }15}{\text{P. }5}$,	*Guttiferae*	$\frac{\text{C. }19}{\text{P. }13}$,	*Ternstroemiaceae*	$\frac{\text{C. }7}{\text{P. }3}$,
Dipterocarpeae	$\frac{\text{C. }46}{\text{P. }12}$,	*Sapindaceae*	$\frac{\text{C. }19}{\text{P. }14}$,	*Myrtaceae*	$\frac{\text{C. }49}{\text{P. }35}$,
Melastomaceae	$\frac{\text{C. }52}{\text{P. }36}$,				

Western Peninsular affinity strongest in Ceylon—

Capparideae	$\frac{\text{C }20}{\text{P. }31}$,	*Tiliaceae*	$\frac{\text{C. }30}{\text{P. }49}$,	*Meliaceae*	$\frac{\text{C. }14}{\text{P. }25}$,
Ampelideae	$\frac{\text{C. }20}{\text{P. }36}$,	*Umbelliferae*	$\frac{\text{C. }10}{\text{P. }33}$,	*Oleaceae*	$\frac{\text{C. }12}{\text{P. }31}$,
Asclepiadeae	$\frac{\text{C. }39}{\text{P. }95}$,	*Boragineae*	$\frac{\text{C. }18}{\text{P. }37}$,	*Acanthaceae*	$\frac{\text{C. }93}{\text{P. }207}$,
Labiatae	$\frac{\text{C. }42}{\text{P. }127}$,	*Liliaceae*	$\frac{\text{C. }18}{\text{P. }39}$,	*Commelinaceae*	$\frac{\text{C. }30}{\text{P. }52}$.

Four Ceylon Orders are absent in the Western Peninsula, *Cactaceae*, *Stylidieae*, *Nepenthaceae*, and *Monimiaceae*; and four Peninsular Orders are absent in Ceylon, *Moringeae*, *Salicineae*, *Gnetaceae*, and *Coniferae*. Of the above, *Cactaceae* is the most noteworthy, being represented by the only species of that vast New World Order which is known to be indigenous in the Old World, namely, *Rhipsalis Cassytha*, also a native of tropical America, Africa, the Mauritius, and Madagascar. The absence in Ceylon of *Coniferae* and especially of *Salicineae* is remarkable, *Salix tetrasperma* being a widely spread Indian shrub or small tree.

Ceylon possesses no fewer than twenty-three endemic genera, of which ten, comprising forty-six species (all but two endemic), belong to the typical Malayan Order of *Dipterocarpeae*, which is represented by only twelve species in the Peninsula. The principal Orders containing very many endemic species are *Orchideae* seventy-four, *Rubiaceae* seventy-two, *Euphorbiaceae* fifty-three, *Melastomaceae* thirty-eight, and *Myrtaceae* twenty-six; and of genera *Strobilanthes*, *Eugenia*, *Memecylon*, *Phyllanthus*, and *Hedyotis*. The genus *Impatiens* abounds; upwards of twenty-one species are recorded, nearly all of them endemic. Of other conspicuous Orders, *Orchideae* contains 160 species, more than half of them endemic. Of Palms, eight indigenous genera, one alone endemic, and eighteen indigenous species, eleven of them endemic, exclusive of the introduced Betel-nut, *Borassus*, and Coco-nut. The Talipot (*Corypha umbraculifera*) is one of the most imposing of the Order. The *Nipa* occurs rarely, Ceylon being its western limit, Australia its eastern. *Cycas circinalis* is common in the forests. Of *Bambuseae* there are five genera and ten species (of which four are endemic).

At elevations above 6,000 feet a few temperate northern genera appear, fewer than might have been expected in mountains that attain heights of upwards of 7,000 and 8,000 feet. Of these genera, *Agrimonia*, *Crawfurdia*, and *Poterium* are not Peninsular. The following are Peninsular: *Anemone*, *Thalictrum*, *Berberis*, *Cardamine*, *Viola*, *Cerastium*, *Geranium*, *Rubus*, *Potentilla*, *Alchemilla*, *Sanicula*, *Pimpinella*, *Peucedanum*, *Galium*, *Valeriana*, *Dipsacus*, *Artemisia*, *Vaccinium*, *Gualtheria*, *Rhododendron*, *Gentiana*, *Swertia*, *Calamintha*, *Teucrium*, *Allium*. Of Peninsular temperate genera that are absent in Ceylon, *Fragaria* and *Rosa* are two the occurrence of which might have been expected, both being Nīlgiri genera.

Remarkable features in the vegetation of Ceylon are the Patanas, grass- or shrub-covered stretches of country, most prevalent in the south-east of the island, from the sea to 5,000 feet altitude. They are partly natural, and partly due to the destruction of the forests and their replacement by subsequently abandoned field-crops. A peculiar, endemic, pale green Bamboo, *Ochlandra stridula*, so called from the crackling noise caused by treading on its broken stems, covers hundreds of square miles of these Patanas. In grassy places *Imperata arundinacea* prevails; and in scrub-forests such tropical trees occur as *Pterocarpus Marsupium*, *Careya arborea*, *Phyllanthus Emblica*, *Terminalia Bellerica* and *T. Chebula*.

At higher levels *Rhododendron arboreum* appears. In moist districts a Fern (*Gleichenia linearis*) occupies the ground[1].

The Maldive Archipelago.

The Maldive Archipelago, a very large group of coral islets with few other flowering plants than Coco-nut Palms, littoral shrubs, and weeds of cultivation, lies about 400 miles SW. of Ceylon, to which the group is politically subordinate. An exhaustive study of their Flora has been published by Messrs. Lewis and Gardiner in the *Annals* of the Peradenya Botanical Garden, who record 284 species of Flowering plants and Ferns. Of these none are endemic, about 160 are indigenous, ninety-eight cultivated, and twenty-six probably introduced by man. *Ardisia humilis* and *Cladium Mariscus* are notable natives of the southern atolls.

The Burmese Region.

Burma is botanically by far the richest Region of British India, and at the same time, as such, the least known. This is due to its great area; to its variety of climates, from a littoral and southern of great humidity to a drier interior, almost arid in places; to its complicated systems of mountain ranges; and to its many geological features and surface soils. The greater portion of Burma having been comparatively recently brought under British rule, very large areas of it are as yet in great part botanically unvisited. This is especially the case with the meridional ranges of Chittagong and Arakan, which extend for 500 miles along the Bay of Bengal, attaining an elevation in parts of 6,000 to 8,000 feet; and with the many continuous or broken, often multiple, ranges bounding Burma on the east from Assam to the Keda State of the Malay Peninsula, which extend for 1,500 miles, and reach even greater elevations. There are also subsidiary longitudinal ranges between the great rivers that have never been botanized, and arid interior areas with little or no rainfall.

The Burmese Region, when better known, will probably prove to be botanically divisible into four Sub-regions, before discussing which some general observations on the cardinal features of its whole Flora are necessary. Its recorded species of Flowering plants amount to about 6,000[2], under 161 Natural

[1] For an excellent detailed account of the Patanas vegetation, see H. H. W. Pearson, F.L.S., in *Journal Linnean Society*, Bot., vols. xxxvi (1899), p. 300, and xxxvi (1903), p. 430.

[2] In the revised and enlarged edition of Mason's *Burma* by W. Theobald (1883), 3,545 species of Flowering plants and 215 of Ferns and their allies are recorded, and the proportion of Monocotyledons to Dicotyledons is 1 to 3·4. The first of these classes has evidently been neglected by collectors, as is shown by *Gramineae* ranking only 8 and *Cyperaceae* 10 in the decad of largest Orders. Mason's Burma is of course the old political Province of

Orders, of which the following ten are the dominant, the numbers following in brackets showing their corresponding positions in the tropical zone of the Eastern Himālayan Region on the north (p. 168):—

1. *Orchideae* (1).
2. *Leguminosae* (2).
3. *Gramineae* (3).
4. *Rubiaceae* (7).
5. *Euphorbiaceae* (5).
6. *Acanthaceae* (10).
7. *Cyperaceae* (6).
8. *Urticaceae* (4).
9. *Compositae* (8).
10. *Scitamineae*.

The proportion of Monocotyledons to Dicotyledons is about 1 to 2·3; of genera to species, 1 to 3·25. One Order alone (*Scitamineae*) is not in the Sikkim decad. *Acanthaceae* are relatively much more numerous in Burma, *Urticaceae* in Sikkim; but these proportions are founded on very insufficient data. Over and above the Orders included in the decad, the following are very largely represented in Burma:—*Magnoliaceae* (21 sp.), *Dipterocarpeae* (26 sp.), *Begoniaceae* (43 sp.), *Melastomaceae* (57 sp.), *Gesneraceae* (60 sp.), *Asclepiadeae* (100 sp.), *Cupuliferae* (44 sp.), *Laurineae* (100 sp.), *Myristiceae* (11 sp.), *Coniferae* (8 sp.), *Cycadeae* (3 sp.), *Palmeae* (68 sp.), *Pandaneae* (12 sp.), *Bambuseae* (68 sp.). Balsams and Ferns abound, but data are wanting for even a rude estimate of their numbers; about fifty Balsams have been collected. The Coniferous genera are *Cephalotaxus*, *Taxus*, *Dacrydium*, *Libocedrus*, *Podocarpus* (2 sp.), and *Pinus* (2 sp.). Of *Orchideae*, 700 species are recorded.

Burma being in the main a forest-clad country, it may be well as an initial step, in sketching what is known of its Flora, to regard it as a whole from this point of view. Fortunately, Kurz in his *Forest Flora of British Burma*[1] has classified the forests as known to him with remarkable lucidity. I shall therefore, before proceeding to indicate the botanical subdivisions of the Region, summarize his chief results, premising that the northern districts, which are politically in Assam, and which I regard as a Sub-region of Burma, are not included in his work.

The forests are classified by Kurz according as they are evergreen or deciduous, in relation to their elevation above and proximity to or distance from the sea, their climatic and geolo-

that name (or Lower Burma), which does not include the northern districts here comprised in botanical Burma.

[1] In this work Kurz has given under each class of forests a multitude of examples of their constituent plants.

gical conditions, and the nature of the soil[1] in which they grow; to which are added observations on their associated plants, shrubby and herbaceous.

1. Evergreen littoral forests. These are estuarial, and of the same character and with the same conditions as the Sundarbans of Bengal. They appear at intervals along the coast, and also on the Andaman Islands.

2. Evergreen swamp forests occupy the low land and depressions in alluvial plains, and borders of lakes and rivers. They shelter a multitude of trees, shrubs, and herbaceous plants, the most characteristic trees being *Mangifera longipes* and *Xanthophyllum glaucum*.

3. Evergreen tropical forests are the most strongly Malayan; they affect the humid coast districts, and are the special home of Dipterocarps, Palms, and Bamboos. They prevail along the coast range from Chittagong to Tenasserim.

4. Evergreen hill forests succeed the tropical above 3,000 feet elevation. Oaks and their allies are characteristic, and, if the climate is sufficiently damp, epiphytic Orchids appear. Above 6,000 feet this forest becomes stunted, and in it Rhododendrons (including *R. arboreum*), *Eurya*, *Rosa*, Honeysuckle, dwarf Bamboos, and other temperate shrubs appear, with *Anemone*, *Viola*, *Gentiana*, the common Bracken, Mosses, and Lichens. The crests of the ridges are often crowned with forests of *Pinus Khasya* towards the north, and of *P. Merkusii* towards the south.

5. Open deciduous forests affect diluvial or older alluvial soils. The Eng (*Dipterocarpus tuberculatus*), whence the name of Eng forest, is the characteristic tree, and there are other species of the same Order, together with a few Oaks, Palms, and Bamboos.

6. Dry deciduous forests recall the vegetation of the Deccan. *Acacia Catechu* is characteristic, and gives its name (Cutch) to a special class of forests in which it is the most valuable tree. The soil is usually calcareous.

7. Mixed deciduous forests are of two classes, an upper and a lower. The upper are restricted to sandstone or metamorphic soils; Teak is the characteristic tree, Palms and Dipterocarps are few, Deccan types are numerous. The lower deciduous forests occupy alluvial soils, and have, consequently, a different undergrowth.

8. Dune forests are deciduous and mixed; they are littoral,

[1] The soils are laterite, or are derived from sandstone or calcareous rocks, or are saline, or swampy.

occupying calcareous sands and gravels. Species of *Erythrina*, *Bombax*, *Afzelia*, and some estuarial plants occur in them, with *Cycas Rumphii* and *Pandanus fascicularis*. *Ipomoea biloba* and creeping grasses cover the sands.

9. Bamboo jungles are formed of many species of *Bambuseae*, often presenting impenetrable thickets and strangling other plants. Seldom are more than two species associated together.

10. Savannahs are limited tracts of what would be swamp forests had they more trees in them. They are covered with tall coarse grasses, as *Saccharum spontaneum*, *Phragmites Karka*, *Polytoca barbata*, many sedges, and in drier places *Imperata arundinacea*.

Assuming Burma as a botanical Region to be divisible into four Sub-regions—Northern, Western, Eastern, and Central—these may be outlined as follows:—

Northern Burma. Northern Burma[1], a mountainous country extending for 500 miles in a NE. direction from the great bend of the Brahmaputra in Bengal to the Chinese Province of Yunnan. Its northern boundary is the range of mountains flanking the Assam valley on the south. Politically it belongs to Assam; and its chief districts, beginning at the west, are known as the Gāro, Khāsi, Jaintiā, Nowgong, Nāgā, Pātkai, and Manipur Hills, the direction of all which is from SW. to NE., except in Manipur, where they trend from N. to S. The average height of these hills may be 4,000 to 5,000 feet, with a few peaks rising to above 10,000. The climate is of maximum humidity; there are no arid areas, as in Central Burma. The vegetation throughout this Sub-region approximates to that of the Eastern Himālayas, differing conspicuously in the absence of an alpine zone, and of any species of *Picea*, *Abies*, *Tsuga*, *Larix* or *Juniperus*, and in the presence of *Pinus Khasya* and of a Pitcher-plant (*Nepenthes*). From that of Central and Southern Burma it differs in the absence of Teak, in the paucity of Dipterocarps, in the presence of the Nepāl and Sikkim Palm *Trachycarpus Martiana*, and of Sāl, which finds its eastern limit in the Khāsi Hills, and of *Pinus Khasya*, which is replaced farther south by *P. Merkusii*. In the valleys and lower elevations the vegetation of the tropical zone of the Himālayas prevails; but at elevations above 4,000 feet temperate genera and species mainly replace it, many of them identical with the Himālayan, though maintaining a lower level by 3,000

[1] This botanical Sub-region is recognized by Major Prain (see *Records of the Botanical Survey of India*, vol. i, p. 284), who refers to it the Lushai Hills, Tippera, Chittagong, Arakan, and the Andaman Islands.

feet or more. Such are, of herbaceous plants, species of *Ranunculus*, *Anemone*, *Thalictrum*, *Delphinium*, *Corydalis*, *Geranium*, *Impatiens*, *Drosera*, *Astragalus*, *Rubus*, *Potentilla*, *Fragaria*, *Sanguisorba*, *Astilbe*, *Parnassia*, *Valeriana*, *Senecio*, *Pedicularis*, *Primula*, *Tofieldia*, *Iris*, *Allium*, and *Paris*. Of temperate shrubs, species of *Berberis*, *Cleyera*, *Camellia*, *Eurya*, *Saurauja*, *Ilex*, *Neillia*, *Luculia*, *Viburnum*, *Ligustrum*, *Rhododendron*, *Vaccinium*, *Gaultheria*, and many others of Himālayan type. Of trees at the high level, among the most conspicuous are *Rhododendron arboreum*, species of *Magnolia*, *Manglietia*, and *Michelia*, *Acer*, *Prunus*, *Pyrus*, *Pieris*, *Bucklandia*, *Alnus*, *Betula*, *Carpinus*, *Quercus* (twenty species), *Taxus*, and *Pinus Khasya*.

A conspicuous feature of the western district of this Sub-region is the open unforested character of elevations above 4,000 feet, reminiscent of the Nīlgiri Hills and presenting genera of trees, shrubs, and herbs common to that far-distant region (see p. 188). It is in one spot of a few yards wide alone in all Burma[1] (in the Jaintiā Hills) that the Pitcher-plant (*Nepenthes khasiana*) is found growing prostrate among wet grass and stones, at an elevation of about 4,000 feet. It is the northernmost known member of this singular genus, its British Indian congeners being natives of Ceylon and the Malayan Peninsula, the latter 1,500 miles to the southward, and they are all climbers. It has not been found elsewhere.

To the eastward the loftier districts of this Sub-region are forest-clad, Bamboos often replacing the arboreous vegetation and dominating the scenery. It is a singular fact that Manipur, the most distant of the districts from Sikkim, possesses species of the latter country not hitherto found elsewhere in Burma.

Western and Southern Burma. The botany of the humid strip of land between the sea and the crests of the Chittagong and Arakan hills differs from that of Central Burma, being interrupted by the estuarial Flora of the deltas of the Irrawaddy, Sittang, and other rivers, eastward of which it reappears along the Tenasserim coast to Mergui. Though many collections have been made in different parts of it[2], these do not suffice to supply a decad of its dominant

[1] In Mason's *Burma* (vol. ii, p. 230) a *Nepenthes* is reported to have been found in Mergui by the Rev. C. Parish, but its discovery has never been confirmed.

[2] Especially in Pegu and Tenasserim. In the latter country Griffith, in 1832, commenced his Indian career as an explorer of botanically unknown regions, which occupied thirteen years of his life without a break, and extended from Afghānistān to the Chinese frontier in Assam, and from Bhutān to the Malay Peninsula. Large collections in the Mergui Province and Archipelago were subsequently made by Mr. Helfer.

Natural Orders. The nature of its tree vegetation may be gathered from Kurz's classification given above, which is that of a dense evergreen forest where Dipterocarps (twenty-six species), Oaks, and Bamboos are conspicuous features, some of the first of these towering over all other trees. Ferns, scandent Palms, and Orchids abound, of which latter Orders novelties are still being sent to botanical establishments in India and Europe. The general character of the vegetation may be gathered from Nos. 3 and 4 of Kurz's classification of the Burmese forests (p. 198). In detail it may be supposed to contain many plants of the temperate tracts of the North Burmese Sub-region.

Eastern Burma.

The Flora of the complicated ranges of mountains intervening between Burma and China on the north and Siam on the south is all but unknown. They have been visited by few botanists or collectors, and their very limited collections throw little light on the interesting question of the community or diversity of the border Floras of these three countries. Only four such collections are known to me: Lieut. Pottinger's in the Kachin Hills, Sir H. Collett's in the Shan States, and those of the Rev. C. Parish and of T. Lobb in the Tenasserim Hills.

Lieutenant Pottinger's collections were made in 1897 at elevations of 450 to 7,000 feet in a mountainous country in the extreme north-east of Central Burma, between lat. 25° and 27° N., and long. 97° and 99° E.: that is, a little to the eastward of the Hukawng valley by which Griffith entered Central Burma in 1836. They were made under great difficulties, owing to the climate and to the hostility of the natives, so that a large proportion of them were lost. In Major Prain's account[1] of this collection he records 601 Flowering plants and twenty-seven Ferns and their allies, of the former of which forty-one are endemic new species, including a new genus of *Leguminosae* (*Cruddasia insignis*), and another allied to *Escallonia*. Not a single Oak is on the list, which is very remarkable (the specimens were presumably lost). Teak here finds its northern limit in Burma (the trees of it were gnarled); as does *Shorea siamensis*, the only Dipterocarp on the list. The Tea plant was found throughout the route. Only four species of *Impatiens* were collected, but many were seen. Of the few plants hitherto supposed to be endemic in China, but now found also in Burma, the most conspicuous were *Wistaria chinensis*, *Rhododendron indicum*, and *Gelsemium elegans*, which latter

[1] *Records of the Botanical Survey of India*, vol. i (1898), p. 215, with two maps. It contains a most instructive article 'On the Nature and Affinities of the Kachin Flora.'

is not included in the Flora of British India, although it had been found in Assam. The following are the ten dominant Orders, with their approximate number of species in each :—

1. *Orchideae*, 77.	6. *Urticaceae*, 20.
2. *Leguminosae*, 60.	7. *Euphorbiaceae*, 18.
3. *Acanthaceae*, 26.	8. *Compositae*, 17.
4. *Rubiaceae*, 25.	9. *Scitamineae*, 17.
5. *Labiatae*, 20.	10. *Aroideae*, 17.

The contrast between the Kachin collection and that made by Sir H. Collett only some 200 miles to the southward in about the same longitude, and for the most part at similar elevations, is startling, and can only be accounted for by assuming that in both cases the number of species collected was too small for an instructive comparison. Of Pottinger's 601 Flowering plants not 100 are recorded among Collett's 843.

Sir H. Collett's collections were made in 1887–8 in Upper Burma and the Southern Shan States: that is, in the valleys of the Salween and Sittang rivers, lat. $19\frac{1}{2}$ to $21\frac{1}{2}^\circ$ N., long. 96 to $97\frac{1}{2}^\circ$ E.; and on Popa (4,000 feet high) in the Irrawaddy valley. They contain 843 species of Flowering plants, which have been enumerated by himself and Mr. Hemsley in the *Journal of the Linnean Society*[1], where no fewer than eighty-three are described as new and endemic. The most remarkable of the novelties were *Osteomeles anthyllidifolia*, a Rosaceous shrub resembling the Blackthorn, previously known as a native of China and of some Pacific Islands, all whose congeners are Andean; a Rose and a Honeysuckle (*Rosa gigantea* and *Lonicera Hildebrandiana*), both with flowers of extraordinary size, and a new genus of *Leguminosae* (*Neocollettia*). The collection contained nine Oaks.

Though so near the Chinese frontier, few species of that country were added to the Burmese Flora; the most interesting was a species of *Speranskia*, a monotypic Chinese Euphorbiaceous genus. About twenty-five of the species and one-fifth of the genera are British.

The following are the ten dominant Orders in Sir H. Collett's collection, with the approximate number of species in each :—

1. *Leguminosae*, 90.	6. *Acanthaceae*, 30.
2. *Gramineae*, 80.	7. *Convolvulaceae*, 29.
3. *Compositae*, 60.	8. *Euphorbiaceae*, 25.
4. *Labiatae*, 41.	9. *Orchideae*, 22.
5. *Rubiaceae*, 30.	10. *Verbenaceae*, 21.

[1] Bot., vol. xxviii (1890), with a full account from Sir H. Collett's pen of the vegetation of the tracts he visited.

The collection, having been made at various elevations between 3,000 and 12,000 feet, is one of mixed tropical and temperate types, the latter descending as low as 4,000 feet, according to Sir H. Collett's observation. The most salient features of the collection are the fewness of *Orchideae* and the large number of *Compositae*; but very many Orchids have since been found in the same collecting ground, chiefly around Fort Stedman and the Tale Lake. *Tectona Hamiltoniana* is included, but not the true Teak (*T. grandis*).

The Rev. C. Parish's collection, and that of Thomas Lobb, a collector for Messrs. Veitch, are chiefly Orchids, of which many interesting species were discovered in the Mulyet and Mokai mountains (altitude 5,000 and 6,300 feet) in Tenasserim. The existence of a *Nepenthes* in Mergui is alluded to on p. 200 (footnote). A more remarkable discovery, if confirmed, is that of a *Rafflesia* in the pass of Ta-ok, east of Moulmein, at an elevation of 3,000 feet, recorded by Mr. Theobald in Mason's *Burma*, vol. ii, p. 828.

Central Burma, between the Arakan ranges and those east of the Sittang river, is divisible into two Sub-regions, a northern dry, and a southern humid, but in what latitude the change of climate becomes marked by the vegetation is not determined; it is, no doubt, irregular in its course, and influenced by the great rivers, by the hills between these, and by proximity to the Arakan range which exhausts the moisture of the south-west monsoon. One small district, that of Minbu, between the Irrawaddy and Arakan, in lat. 20° N., is spoken of as being a desert, no doubt figuratively [1]. The character of the upper Central vegetation is largely that of the drier parts of Western India; it agrees with that of No. 6 in Kurz's classification (p. 198) in being mainly dry deciduous. Two species of Teak (*Tectona grandis* and *T. Hamiltoniana*) occur, with many Leguminous trees, *Acacia Catechu* often forming forests, and more rarely *Dipterocarpus tuberculatus*. Central Burma.

The Andaman Islands have been visited by botanists at few and distant points only, of which the chief is Port Blair. Kurz collected in them 560 species of Flowering plants [2]; and Major The Andaman Islands.

[1] Quite recently this specially arid district has been botanized by Capt. Gage of the Calcutta Botanical Garden, under the direction of Major Prain, and the results have been published in the *Records of the Botanical Survey of India*.

[2] See for details his Report to the Indian Government on the vegetation of the Andamans, where the species are all enumerated and discussed. *Memoirs and Memoranda* by D. Prain, Calcutta, 1894.

Prain, who visited several of the smaller islets, Barren Island, Narcondam, and the Coco, as well as one of the main islands, added perhaps 150 to Kurz's record. The total would probably not exceed one-third of the whole Flora. The forests with which most of the Archipelago is clad are typically Burmese, and are regarded by Kurz as a less developed stage of his seventh class, mixed evergreen and deciduous. Their most remarkable feature is the apparently total absence of the Cupuliferous genera *Quercus* and *Castanopsis*, of the first of which there are forty species on the neighbouring continent, and of the second eleven. Of *Dipterocarpeae* there are very few, but owing to the number of their individuals and gigantic stature they form the dominant feature of the forests; of *Myristica* there are four. Considering, however, that nothing is known of the vegetation over nearly the whole of the Archipelago, and that its interior hills, which reach 2,400 feet in altitude, have not been botanized over, it is evident that it would be premature to regard the apparent absence of *Cupuliferae* as ascertained fact, or indeed that of any of such other desiderata as Mr. Kurz indicates, namely *Magnoliaceae*, *Onagraceae*, *Umbelliferae*, *Vacciniaceae*, *Scrophularineae*, *Labiatae*, *Polygoneae*, *Amarantaceae*, *Chenopodiaceae*, *Coniferae*, *Pontederiaceae*, *Amaryllideae*, and other small families, and all freshwater plants. One Coniferous plant (*Podocarpus*) is included in his *Forest Flora* as a native of the Andamans, and others of the desiderata have, since the publication of that work, been found by Major Prain.

Mr. E. M. Buchanan, of the Forest Department, informs me that the absence of grasses like *Saccharum*, *Panicum*, and *Imperata*, and of all indigenous erect Bamboos except *B. schizostachyoides*, is a peculiar feature of the Andaman vegetation, and that their belts of pine forest on silty deposits facing the sea seem to have no parallel in Burma or the Nicobars.

The Nicobar Islands.

The Nicobar Islands are even less known botanically than the Andamans, and it is questionable whether they belong to the Burmese or to the Malay Peninsular Flora. They were visited both by Mr. Kurz[1], who collected on Katchall and Camorta 573 Flowering plants and fifty Ferns and their allies, and by Major Prain, who obtained 110[2] on the islets of Car Nicobar, Batti Malv, and a few other localities, adding considerably to his predecessor's list. The general character of their vegetation is that of the Andamans, with the apparent

[1] See *Journal of the Asiatic Society of Bengal* (1876), p. 105.

[2] Enumerated and fully discussed in his *Memoirs and Memoranda*.

absence of *Dipterocarpeae*, *Datiscaceae*, and the *Podocarpus*. The presence in the Nicobars of a genus of *Monimiaceae*, an Order elsewhere in British India confined to the Malayan Peninsula and Ceylon, would indicate a closer affinity with those Regions. On the other hand, the occurrence of *Capparis ambigua*, a plant confined to the two Archipelagoes, indicates a community in their Floras. It would be interesting to know whether any species of *Nepenthes*, of which eight are found in the Malay Peninsula, exist in the Nicobars.

The Malayan Peninsula Region.

Except the Island of Penang, and the Protected States of Perak, Selangor, and the British territories of Wellesley, Malacca, and Singapore, little is known of the Flora of the Malay Peninsula, the greater part of which is under Siamese dominion. Of the range of mountains which forms its backbone and which rises to peaks 4,000 to 7,000 feet in height, a few have been visited botanically, including one (7,000 feet) in Perak, and Mt. Ophir (4,183 feet) in Malacca. It is hence obvious that materials do not exist for estimating with any approach to finality either the Flora as a whole or the relative number of its dominant Natural Orders.

Except where cultivation interferes, the whole Peninsula is clothed with an evergreen vegetation, that of the shore being estuarial. Mr. Ridley informs me that the number of recorded species of Flowering plants from this Region in the rich herbarium of the Royal Gardens at Singapore is 4,547, and of Ferns and their allies 368; but this does not include many species discovered by collectors sent from the Royal Gardens, Calcutta, which are in course of publication[1] by Sir George King. The ten dominant Orders are, as given me by Mr. Ridley, the following, to which I have added in brackets their corresponding position in the Burmese decad :—

1. *Orchideae* (1).
2. *Leguminosae* (2).
3. *Euphorbiaceae* (5).
4. *Rubiaceae* (4).
5. *Anonaceae*.
6. *Gramineae* (3).
7. *Scitamineae* (10).
8. *Melastomaceae*.
9. *Cyperaceae*.
10. *Urticaceae* (8).

The proportion of Monocotyledons to Dicotyledons is 1 to 2·2, and of genera to species 1 to 2·3. The numbers attached

[1] In the *Journal of the Asiatic Society of Bengal*, where descriptions are, or will be, given by Sir G. King of all the known Flowering plants of the Malay Peninsula. The large Orders not yet worked up for that work, which may interfere with the sequence of the above decad, are *Euphorbiaceae*, *Laurineae*, and *Urticaceae*.

to the Orders in this decad afford striking evidence of the difference between the Floras of Burma and of the Malay Peninsula, which may be even more forcibly illustrated by the following contrasts, where the letters M. and B. represent the two Regions:—

Orders with a great preponderance in the Malayan Peninsula—

Dilleniaceae	$\frac{\text{M. 18}}{\text{B. 8}}$,	*Bixineae*	$\frac{\text{M. 24}}{\text{B. 11}}$,	*Guttiferae*	$\frac{\text{M. 66}}{\text{B. 20}}$,
Dipterocarpeae	$\frac{\text{M. 73}}{\text{B. 26}}$,	*Polygaleae*	$\frac{\text{M. 32}}{\text{B. 16}}$,	*Meliaceae*	$\frac{\text{M. 90}}{\text{B. 39}}$,
Anacardiaceae	$\frac{\text{M. 67}}{\text{B. 35}}$,	*Connaraceae*	$\frac{\text{M. 33}}{\text{B. 15}}$,	*Myrtaceae*	$\frac{\text{M. 123}}{\text{B. 66}}$,
Melastomaceae	$\frac{\text{M. 136}}{\text{B. 53}}$,	*Myristicaceae*	$\frac{\text{M. 47}}{\text{B. 9}}$,	*Nepenthes*	$\frac{\text{M. 7}}{\text{B. 1}}$,
Palmeae	$\frac{\text{M. 10}}{\text{B. 68}}$.				

Orders with a great preponderance in Burma—

Capparideae	$\frac{\text{M. 14}}{\text{B. 20}}$,	*Balsamineae*	$\frac{\text{M. 7}}{\text{B. 40}}$,	*Leguminosae*	$\frac{\text{M. 297}}{\text{B. 380}}$,
Rosaceae	$\frac{\text{M. 33}}{\text{B. 66}}$,	*Compositae*	$\frac{\text{M. 27}}{\text{B. 160}}$,	*Acanthaceae*	$\frac{\text{M. 34}}{\text{B. 226}}$,
Labiatae	$\frac{\text{M. 10}}{\text{B. 46}}$,	*Cupuliferae*	$\frac{\text{M. 37}}{\text{B. 46}}$,	*Bambuseae*	$\frac{\text{M. 22}}{\text{B. 68}}$.

This latter statement demonstrates the much stronger affinity of the Burmese Flora with that of the Deccan. The maximum difference between the two Regions is shown by the genus *Impatiens*, the seven Malay Peninsula species being altogether different from the forty Burmese. One species is the most singular of all known Balsams (*I. mirabilis*), with a simple or branched trunk often four feet high and as thick as a man's leg. It is a native of the small islet of Terutan, one of the Lankauwi group, and of the adjacent coast of West Siam.

The Malayan Peninsula is much richer in Palms than is any other region of British India. Upwards of thirty genera and 150 species are recorded, and these numbers will no doubt be exceeded in the forthcoming history of Indian Palms which is about to appear from the pen and pencil of Dr. Beccari of Florence, in the *Annals* of the Royal Botanic Garden, Calcutta. Both generically and specifically the Malayan Palms differ from those of Burma, and find their affinities with those of Sumatra and other islands of the Eastern Archipelago. To this, however, there appears to be one remarkable exception, for Mr. Ridley informs me by letter that an undescribed species of *Borassus*, an essentially African genus, of which one species is commonly cultivated all over the plains of India, has been recently found in the forests of Perak.

Of Bamboos fewer Malayan species have been recorded than of Burmese, but more than in the Malabar region.

About twenty-two species, under five genera, are known, most of them endemic or common to the adjacent islands. Of Conifers eight species are recorded for the Malayan Peninsula, belonging to the genera *Agathis*, *Dacrydium*, and *Podocarpus* (five species); of *Cycadeae*, only *Cycas Rumphii*. The small Order *Monimiaceae*, of which two species are natives of the Malay Peninsula, is unknown in Burma (though inhabiting the Nicobars), but is represented by two species in Ceylon. The most notable plants of the Peninsula are perhaps two species of the stemless and leafless root-parasites, *Cytinaceae*, namely, *Brugmansia Lowi*, and a *Rafflesia* probably identical with the famous *R. Arnoldi* of Sumatra; and seven species of the Pitcher-plant (*Nepenthes*).

The islet of Penang, lying opposite the coast of Wellesley, distant ten miles, demands a separate notice, if only for the fact of the astonishing number of species, and so many of them arboreous, that it contains. Though its area is only 106 square miles, and its greatest elevation 2,750 feet, yet, according to a catalogue of its Flowering plants drawn up and printed (1894?) by Mr. C. Curtis, F.L.S., Assistant Superintendent of its Forests, it contains 1,813 species, together with 173 Ferns and their allies. With the exception of one, the tenth (*Apocyneae* replacing *Scitamineae*), the ten dominant Orders are the same as those I have given as the decad of the whole Peninsula, but they do not follow the same sequence, *Rubiaceae* ranking first, *Leguminosae* fourth, and *Orchideae* third; and the proportion of Monocotyledons to Dicotyledons is very different, 1 to 4·1. Other Orders largely represented are *Myrtaceae* thirty-five, *Acanthaceae* thirty-one, *Dipterocarpeae* twenty-eight, *Myristicaceae* and *Guttiferae* twenty-five each, *Cupuliferae* seventeen (of which thirteen are Oaks), Palms thirty-four. Of *Compositae* there are only twenty-three, of Bamboos one only, of *Nepenthes* three, of Gymnosperms eight (*Gnetum* four, a *Dacrydium*, *Agathis*, and two *Podocarpi*).

Penang Islet.

The Cocos and Keeling islets, in the South Indian Ocean, 500 miles S.W. of Java, and still more distant from Singapore, are British possessions, which have in recent years been transferred from the Government of Ceylon to that of the Federated Malay States. Their scanty Flora is purely tropical Indian, and in great part littoral. Mr. H. B. Guppy spent ten weeks there, and made a very interesting collection of seeds and fruits cast up on the shores of Keeling's Island, of which a list has been published by Mr. W. B. Hemsley, F.R.S. (See *Nature*, xli. 491, 492; and *Science Progress*, i. 40.)

Cocos and Keeling islets.

APPENDIX A

The Kurram Valley

The Kurram Valley.

The Kurram is the only valley in the long range of mountains bordering British India on the west of the Indus of which the Flora has been described. It was exhaustively explored by Surgeon-Major J. E. T. Aitchison, F.R.S., in 1879–80, who collected in it about 900 species of Flowering plants, and twenty-six Ferns and their allies[1]. The valley is nearly 100 miles long, and the elevations at which the collections were made varied from 2,000 feet above the sea at the mouth of the valley to 15,000 feet on its flanks: that is, from the tropical Flora of the Indus Plain to the alpine of the Himālayas. Of the ninety-three Orders to which the Flowering plants belong, the following ten are the dominant. The added numbers in brackets indicate the positions of the same in the Western Himālayan Region:—

1. *Compositae* (2).	6. *Cruciferae* (8).
2. *Gramineae* (1).	7. *Umbelliferae*.
3. *Leguminosae* (3).	8. *Ranunculaceae* (6).
4. *Labiatae* (5).	9. *Boragineae*.
5. *Rosaceae* (9).	10. *Cyperaceae* (4).

The low position of *Cyperaceae*, and the subjection of *Gramineae* to *Compositae*, may be attributed to the dryness of the climate, as also may the prevalence of *Boragineae*. The genera and most of the species are Himālayan, the chief exceptions being such plants as *Herniaria* and *Peganum*, which are typical of the Indus Plain. The nine *Coniferae*, which include the Deodār, are all Himālayan. The only Palm is *Nannorrhops Ritchieana*, which extends from the Salt Range to Sind and Baluchistān. The distinctively Oriental genera, such as *Pistacia* and *Eremurus*, are few. Of *Bambuseae* there are none. On the whole, the Flora may be regarded as a dying-out Himālayan, and not as typically Oriental. It differs considerably from that of British Baluchistān.

[1] *Journal of the Linnean Society of London*, Bot., vols. xviii and xix.

APPENDIX B

British Baluchistān

THE small tract of country (about 180 miles long) bearing this name is enclosed between Afghānistān and Baluchistān proper. It is mountainous, 5,000 to 8,000 feet elevation above the sea, with peaks rising above 10,000 feet, and its climate is one of great extremes of cold and heat. Not having been brought under British administration until the early volumes of the *Flora of British India* were considerably advanced, its plants were not taken up in that work. British Baluchistān.

Only three botanists have collected in it. Griffith[1] in the spring of 1839 passed through it when accompanying the army of the Indus from Shikārpur to Kandahār, Dr. Stocks[2] visited it in the spring of 1850, and Mr. J. H. Lace, F.L.S. (of the Indian Forest Department), resided in it from 1885 to 1888. Some of the plants collected by the first two travellers are included in Boissier's *Flora Orientalis*, and excellent observations on the vegetation of the country are published in the works cited below. Mr. Lace alone was enabled to make a detailed botanical exploration of the district. He collected upwards of 700 species, which, aided by Mr. Hemsley, he has published[3], prefacing his account with an exhaustive description of the botanical features of the country. These materials prove the Flora to be Oriental, with an admixture of Himālayan and Indian plants; it is Afghān, in short, and very different from that of the Indus Plain, and of Baluchistān in its lower levels, which is more Arabic-Persian. It may be gathered from the observations of these three botanists that the vegetation, though poor, is very varied and presents many local assemblages of species, dependent upon climate, soil (including saline), humidity, and elevation within a very limited area. The ten dominant Orders of the eighty-two in Mr. Lace's

[1] *Posthumous Papers*, vol. i, p. 336.

[2] Hooker's *Journal of Botany*, vol. ii (1850), p. 303; vol. iv (1852), pp. 142, 172.

[3] 'Sketch of the Vegetation of British Baluchistān, with Descriptions of New Species,' *Journal Linnean Society*, Bot., vol. xxviii (1891), p. 288.

collections are the following, with, in brackets, their relative positions in the Kurram Valley Flora:—

1. *Compositae* (1).	6. *Chenopodiaceae*.
2. *Gramineae* (2).	7. *Boragineae* (9).
3. *Leguminosae* (3).	8. *Liliaceae*.
4. *Cruciferae* (6).	9. *Caryophylleae*.
5. *Labiatae* (4).	10. *Rosaceae* (5).

Of the eighty-two Orders, no fewer than twenty are monotypic, including *Acanthaceae*, which is well represented in every other botanical Region of India. The forest trees are *Juniperus macropoda* (the only Conifer), which is found at 7,000 to 10,000 feet elevation; *Populus euphratica* and species of *Pistacia*, *Dalbergia*, *Celtis*, *Acacia*, *Prosopis*, *Salix*, *Fraxinus*, *Ulmus*, *Crataegus*, and *Tamarix*. (The Oriental Plane included in Mr. Lace's list I assume to have been introduced.) The Pomegranate and Fig are indigenous. *Nannorrhops* is the only Palm. There are no *Bambuseae* in the collections, and only six Ferns.

Before concluding, it must be recorded that the very considerable European and Oriental Order of *Cistineae* has its extreme eastern limit in Native Baluchistān. Stocks collected *Helianthemum Lippii*, a widely distributed species extending from the Levant to Persia, near Gandāva, sixty miles south of the British frontier. Should it be found within the latter it would add a Natural Order of plants to British India.

J. D. HOOKER.

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CHAPTER V

ZOOLOGY

ANIMAL life is not only abundant in British India, but it is remarkably varied. The contrast between the damp, tropical, richly wooded hill ranges of Malabar or Tenasserim and the cold barren islands of Ladākh in the Upper Indus drainage area is absolute, and the difference in the animals found is as great as in the climate. The beasts, birds, reptiles, and insects that inhabit the dense forests east of the Bay of Bengal and the mangrove swamps of the Burmese coast, where the annual rainfall exceeds 100 inches, could not exist in the almost rainless deserts of Sind and the Punjab. Although the Fauna of the dry regions is poor, that of the damp forests of Malabar, the Eastern Himālayas, Assam, and Burma is singularly rich; and the combined effect of local richness and of great differences of climate is that the number of kinds of animals inhabiting India and its dependencies is very large, far surpassing, for instance, that of the species found in the whole of Europe, although the superficial area of Europe exceeds that of the Indian Empire by about one-half. Richness of Fauna.

The following figures show the number of genera and species of Vertebrates described in the eight volumes of the *Fauna of British India* (1888–98). The lists include animals found in Ceylon as well as those of India and Burma:—

	Genera.	Species.
Mammals . . .	115	401
Birds	593	1,617
Reptiles . . .	146	534
Batrachians . .	24	130
Fishes	351	1,418

A few additions have since been made, but the increase is small except in the fishes. The number of Indian Invertebrata is very large, but few groups are sufficiently known for a trustworthy estimate to be made. Of moths alone 5,618 species were described by Sir G. Hampson as having been discovered up to 1896, and some hundreds have since been added.

Nearly the whole Indian area is included within the zoological region known as Indo-Malay, Oriental, or Indian, which comprises South-eastern Asia and the neighbouring islands. Distribution of Fauna.

The Punjab, Sind, and Western Rājputāna, however, have a Fauna differing considerably from that of other parts of India, and resembling that found in South-western Asia and Northern Africa, whilst the animals of the Higher Himālayas and the Upper Indus Valley resemble those of Central Asia; and both of these areas belong to the zoological region extending over the greater part of Asia and all Europe, and known as Holarctic or Palaearctic. After distinguishing these two areas as the Punjab and Tibetan provinces or sub-regions, the remainder of the country may be divided into three well-defined zoological areas, each characterized by marked features. These are:—

(1) The Indian Peninsula, from the base of the Himālayas and as far east as the head of the Bay of Bengal, together with Ceylon;
(2) The forest-clad Himālayas, Assam, and Burma, as far south as the neighbourhood of Mergui; and
(3) Southern Tenasserim, which is part of the Malay Peninsula, and belongs, with the greater part of the Malay Archipelago, to the Malayan sub-region.

The first is known as the Indian or Cis-Gangetic sub-region; the second, which includes Southern China, Siam, and Cochin China, as the Himālo-Burmese or Trans-Gangetic. It will easily be understood that animal life is by no means uniform even within these subdivisions: thus, the forests of the Konkan, Malabar, and South-western Ceylon harbour a far richer Fauna than that found in the Bombay Deccan, the Carnatic, or Northern Ceylon; and while the animals of the Eastern Himālayas closely resemble those of Burma, the Burmese types die out gradually in the Himālayas to the westward and are replaced by kinds inhabiting the temperate parts of Asia.

It is proposed in the present sketch to pass briefly in review the principal Vertebrate animals of India, beginning with the higher forms. The Mammals will therefore be first noticed, and among them the monkeys, as being the most highly organized. To deal with the Invertebrata in a similar manner would require more space than can be spared.

Mammals

Primates. The monkeys of India are numerous, and some of them are among the commonest wild animals of the country. The Apes (Simiidae), distinguished by the absence of tails, are no longer found in India itself or the Himālayas, though they may

at one time have been reckoned among the inhabitants, for remains of animals closely related to the Chimpanzee of Africa and the Orang-utan of the Malay Archipelago occur in the Pliocene Siwālik beds at the base of the Western Himālayas. But two species of Gibbon (*Hylobates*), which, although much smaller, resemble man in some details of structure as much as do the Gorilla and Chimpanzee, are found in Assam and Burma. One of these is the White-browed Gibbon or Hoolock, the latter name being derived from the animal's call; the other is the White-handed Gibbon. Both inhabit forests in large parties, and are conspicuous by their agility and by the speed with which they travel, holding on by their long arms and throwing themselves from branch to branch, and from tree to tree. They feed chiefly on fruit, but partly on insects, the eggs of birds, and such small birds as they can capture. Wherever they are found they make their presence known by their loud and not unmusical calls, frequently uttered in chorus.

The common monkeys (*Macacus*), called *bandar* in Northern India, are found almost throughout the Empire. Eight or nine species are known within Indian limits, comprising the long-tailed Macaque or Crab-eating Monkey (*M. cynomolgus*) of Burma and the Malay countries; the similarly long-tailed Bonnet Monkey (*M. sinicus*) of Southern India, and the Toque Monkey (*M. pileatus*) of Ceylon; the shorter-tailed Bengal or Rhesus Monkey (*M. rhesus*) of Northern India, with its ally the Himālayan Monkey (*M. assamensis*), which is found throughout the Himālayas; the Lion-tailed or Silenus Monkey (*M. silenus*), often wrongly called 'Wanderoo' by European naturalists, from the hills near the Malabar coast; the Pig-tailed Monkeys (*M. nemestrinus* and *M. leoninus*) from Burma and Malayana; and a monkey with a very short, almost rudimentary tail, known as the Brown Stump-tailed Monkey (*M. arctoides*), also Burmese. All of these live in flocks of considerable size, and inhabit trees, but often descend to the ground. They are active animals, though much less so than the next group. None are large; they rarely exceed in size a fox terrier, and generally are about as big as a domestic cat, but old males greatly exceed ordinary members of the flock in dimensions. They live chiefly on fruit, grain, seeds, &c., but all eat insects as well; one kind subsists largely on crabs and other crustacea, and individuals have been seen devouring lizards and frogs. All are occasionally tamed and many are very gentle and affectionate, but they are rarely docile and

often ill-tempered. Among those most commonly tamed are the three long-tailed species, and the Rhesus, all of which are carried about by jugglers and mountebanks throughout India, and taught to go through various performances. Those who have only seen monkeys in cages are apt to form a low idea of the intelligence, love of fun, and power of imitation which these animals possess.

The last genus of Indian monkeys consists of the Langurs or Hanumāns, renowned in Indian legend for having aided Rāma in his expedition to Ceylon in pursuit of Rāvana, the ravisher of Sita. They are larger monkeys, with longer limbs and tails, than the Macaques; and flocks of the common Hanumān of Northern India (*Semnopithecus entellus*), being generally protected and even regarded as sacred animals by many Hindus, are commonly found in groves near villages, or even in the village trees, and it is not unusual to see them perched on the roofs of houses. They are purely vegetable feeders, their food consisting of the young shoots and leaves of trees, with fruit and grain. They are very active, whether on the ground or on trees, and run, or rather bound, on all fours with great rapidity for a short distance. Their calls are loud and peculiar, the principal being a joyous, rather musical whoop, uttered when bounding or playing about; another is a harsh guttural note, denoting alarm or anger—a familiar signal to many sportsmen, for it is the sound uttered by the Hanumān who has seen a tiger. In confinement Langurs are sedate and indolent, and sometimes morose and savage, and they are but rarely long-lived. Two grey species (*S. entellus* and *S. priamus*) inhabit the Indian Peninsula, one in the north and the other in the south and in Ceylon, in the more open parts of the country, while at least four other species of darker hue are found in the hills and forests of Southern India and Ceylon. One of these (*S. johnii*), which is quite black, occurs on the plateau of the Nīlgiris and in the Anaimalai and Travancore ranges; another kind, the Purple-faced Monkey (*S. cephalopterus*), is met with throughout Ceylon at low or moderate elevations. It is to these Ceylon Langurs that the name Wanderoo, wrongly applied to the Malabar Lion-tailed Macaque by European naturalists, properly belongs. A large kind of Langur (*S. schistaceus*) is found in the Himālayas from Kashmīr to Bhutān, at elevations of from 5,000 to 12,000 feet, and has been observed sporting amongst fir-trees loaded with snow. Five more species are met with in parts of Assam and Burma.

The majority of the living forms of Lemurs are peculiar to Madagascar, but two species inhabit the Indian area. One of these, the Slender Loris (*Loris gracilis*), is met with in the lowland forests of Southern India and Ceylon; the other, the Slow Loris (*Nycticebus tardigradus*), occurs throughout the countries east of the Bay of Bengal, from Assam to Borneo and Java. No kind of Lemur is found in Northern India or the Himālayas. Lemurs are nocturnal and arboreal animals, and slow in movement; they feed on leaves and shoots of trees, fruit, insects, birds' eggs, and young birds.

Carnivora.

The Carnivores include the wild beasts of story, the *bêtes fauves* of the French; and comprise, in India, cats, civets, ichneumons, hyenas, dogs, martens, weasels, badgers, otters, and bears, while an aberrant member of the racoon family is found in the Himālayas. Seals are the only important section of the Order not represented in the Indian Fauna.

Of the family of cats (Felidae) no less than seventeen species are found within Indian limits. Three of these, however—the Ounce or Snow Leopard (*Felis uncia*), Lynx (*F. lynx*), and Pallas's Cat (*F. manul*)—are confined within our area to Tibet and the Higher Himālayas, while the Lion, now almost extinct in India, and the Indian Desert Cat (*F. ornata*) inhabit only the drier north-western parts of the country. The Caracal (*F. caracal*) and the Hunting Leopard (*Cynaelurus jubatus*) have, like the Lion, a wide range in Western Asia and in Africa, and both occur sparingly throughout a considerable portion of the Indian Peninsula, but not in the southern extremity nor in Ceylon. On the other hand, the Rusty-spotted Cat (*F. rubiginosa*) is peculiar to Ceylon and Southern India, while three kinds—the Clouded Leopard (*F. nebulosa*), the Marbled Cat (*F. marmorata*), and the Golden Cat (*F. temmincki*)—occur in the Eastern Himālayas and range through Burma to the Malay countries. The remaining Indian cats, five in number (neglecting the doubtful *F. torquata*)—the Tiger, Leopard or Panther, Fishing Cat (*F. viverrina*), Leopard Cat (*F. bengalensis*), and Chaus or Jungle Cat (*F. chaus*)—are more or less generally distributed throughout India and Burma. The distribution of the family Felidae affords a fair epitome of that of the animal kingdom generally within the Indian Empire.

The larger cats are too formidable and important to be passed over without special mention. The lion was formerly found throughout the greater part of North-western and Central India. In the early part of the nineteenth century lions occurred in Hariāna, Khāndesh, and Rewah, and as far east as

Palāmau, whilst up to 1860 or 1870 many existed in Kāthiāwār and parts of Rājputāna. Now the last remaining Indian lions are said to be confined to the Gīr in Kāthiāwār. Tigers, though their numbers have been greatly diminished, are still found in all the wilder parts of India and Burma; but none occur, or, so far as is known, ever have occurred, in Ceylon, a circumstance which may indicate that the tiger is a comparatively modern immigrant into Southern India, and did not exist there when Ceylon formed part of the continent. Tigers ascend the Himālayas occasionally to a height of 6,000 or 7,000 feet, though they generally keep to the base of the range. The lion is an inhabitant of rocky and sandy ground with brushwood, the tiger chiefly of forest and high grass near water. Both live on deer, antelope, and wild hog, and when they have an opportunity, kill cattle, horses, and even camels, for food. Both attack human beings occasionally; but the destruction of human life by tigers in India is mainly, if not entirely, due to a small minority of these animals. Ordinary tigers never kill men for food; the terrible man-eater is a tiger, or perhaps more often a tigress, which, owing to age or partial disablement, or to the need of finding food for its young when game is scarce, has through hunger got over its fear of man, and has learned that he is the easiest prey to find and kill. Owing to the steady destruction of tigers in India, the tale of human victims has diminished, and only 866 deaths caused by tigers were reported in 1903, whilst forty years ago 700 people were said to be killed yearly in Bengal alone. Male tigers in Northern India weigh about 450 to 500 pounds, tigresses 350 to 400 pounds; but in Southern India the weights appear to be rather less.

Leopards or panthers are more widely distributed than tigers, and are scarcely less destructive. They are bolder and care less for the neighbourhood of water; hence they are often found both in rocky hills and in gardens about villages. They vary in size and markings so much that many people, both Europeans and Indians, are of opinion that there are two different kinds in India; and in some parts of the country, as in the Central Provinces, there appear to be two distinguishable varieties, one much larger than the other. But when many are compared it is impossible to find any constant distinctions. Black individuals occur not unfrequently in particular areas, as in Travancore, in Cāchār, and again in the Malay Peninsula. (A black tiger was once recorded in Chittagong.) Leopards live upon any animals they can kill, and they

have a particular liking for dogs. Several cases are on record of leopards that have become regular man-eaters.

Of the other cats, the Fishing Cat haunts the banks of rivers and marshes, and feeds chiefly on fish; the Ounce inhabits the Higher Himālayas and kills sheep and goats, wild or tame; the Clouded Leopard, Marbled Cat, Golden Cat, and Leopard Cat are forest hunters, living much in trees; and the Chaus and Rusty-spotted Cat prefer grassy plains.

The Hunting Leopard, generally known in Europe as the Cheetah (a name signifying 'spotted,' and quite as often applied in India to the panther), is placed in a different genus (*Cynaelurus*) on account of its claws being only partially retractile and of its lighter build. It is not a common animal in India, and would attract little attention but for the circumstance that it has from time immemorial been tamed and used for hunting antelopes, which it catches by means of its extraordinary speed. The Indian antelope or black buck is, for its size, one of the swiftest animals known, yet a good observer records that he saw one with a start of 200 yards run down by a hunting leopard before it had traversed 400 yards more. This great speed can be exercised by the hunting leopard for a short distance only.

The civet family (Viverridae) is represented in India and Burma by twenty-one species, eight of which belong to the sub-family of ichneumons or mungooses. The true civets are four in number: the Large Indian Civet (*Viverra zibetha*), found in Bengal, Orissa, Assam, Burma, &c.; the Malabar Civet (*V. civettina*), a representative form on the Malabar coast; the Burmese Civet (*V. megaspila*), occurring in Burma and the Malay countries; and the small Indian Civet (*Viverricula malaccensis*), inhabiting nearly the whole of India and Burma, with Southern China, Siam, &c. All are somewhat arboreal in their habits, and live partly on small animals and birds, partly on fruits and roots. The drug known as civet is obtained from these animals, which are kept in cages for the purpose of collecting it. Allies of the civets are the Linsangs or Tiger-civets (*Linsang* or *Prionodon*), represented by one very pretty spotted species (*L. pardicolor*) in the Eastern Himālayas and Burma, and by a larger form (*L. maculosus*) in Tenasserim; and the Palm Civets (*Paradoxurus*), often called in India toddy-cats. The latter are common in all wooded parts of India and Burma, but owing to their nocturnal habits are but rarely seen. They have long tails, and are grey and black or brown in colour; they live on

small animals, birds, lizards, and insects, and also on fruit and vegetables. Not infrequently individuals come into houses. The last of the sub-family, the Binturong or Bear Cat (*Arctictis binturong*), called the Monkey Tiger (*myouk-kya*) in Burma, is larger than the *Paradoxuri*, and measures about 2½ feet from nose to insertion of tail. It is a forest dweller, and is found east of the Bay of Bengal from Assam to Sumatra and Java. The colour is black. The most remarkable peculiarity about this animal is its possession of a truly prehensile tail, by which, at all events when young, it can suspend itself. It is the only known animal of the old continent—Europe, Asia, and Africa—that has this power.

The genus *Herpestes*, comprising the ichneumons, contains eight Indian or Burmese species varying in size and colour. Of these the best known is the Common Indian Mungoose (*Herpestes mungo*), renowned as the deadly enemy of snakes, and famous in Indian folk-lore for its reputed acquaintance with an antidote to the poison of the cobra, a herb or root known as *munguswel*. The story is apocryphal: the mungoose is so quick and agile that it generally avoids the snake's fangs and seizes its adversary by the head; but if effectively bitten the mungoose, although apparently less quickly affected than other animals of a similar size, succumbs to the poison. Besides the common mungoose, which weighs about 3 lb., and is found throughout India and Ceylon, there is a smaller species (*H. auropunctatus*) inhabiting Northern India and Burma, and others occur in Southern India and Ceylon, one of which (*H. vitticollis*) is the largest Asian ichneumon. Another large kind (*H. urva*) inhabits the Himālayas and Burma, and is said to haunt the neighbourhood of streams and to feed on crabs and frogs.

The Striped Hyena (*Hyaena striata*) is the only member of the family Hyaenidae now occurring in India, though remains of the Spotted Hyena, at present confined to Africa, have been discovered in the Pleistocene deposits of the Kurnool caves, and several species are represented in the Pliocene Siwāliks. Hyenas are not found in Ceylon, nor in countries east of the Bay of Bengal; but they are common throughout the Peninsula of India, chiefly in fairly open country, where there are rocky hills and ravines. The striped hyena lives chiefly on dead animals, often on the bones which have been picked by vultures, and which it breaks with its powerful jaws; but it occasionally carries off dogs, goats, and other small beasts. Its presence, wherever it occurs, is easily recognized by its peculiar dog-like

tracks, in which the marks of the hind feet are much smaller than those of the fore feet, and by its droppings, which are hard, white, and not readily decomposed.

The dog family are represented by two wolves, a jackal, two so-called wild dogs, and five foxes. One of the wolves appears to be a race of the European Wolf (*Canis lupus*), and is found in the Punjab and Sind; while another variety of the same species, sometimes black in colour, inhabits Tibet. The Indian Wolf (*C. pallipes*), chiefly distinguished by smaller size, is met with throughout the Peninsula. Neither wolves nor foxes are known to occur in Ceylon or Burma. The Indian wolves, despite their smaller size, are dangerous animals, and in parts of the country carry away many children, besides numerous goats and sheep. They also kill antelopes, hares, and other small animals, such as foxes and occasionally dogs. There is, however, in many parts of India, a great aversion to destroying wolves, in consequence of a widespread belief that the blood of a wolf, if shed on the lands of a village, renders them unfruitful. Stories about children carried away and reared by wolves are common in Northern India, but it is doubtful whether any are authentic. The children said to have been thus brought up appear always to have been idiots.

The Indian Jackal (*C. aureus*) is one of the commonest and most familiar animals of the country, inhabiting the whole of India and Ceylon, but is very rare east of the Bay of Bengal. He is the common scavenger of towns and villages, feeding on carrion and offal of all kinds, from which he drives off the crows and vultures; but he also occasionally kills small animals or poultry, and at other times lives on fruit or sugar-cane. His cry, a long wailing howl three or four times repeated, followed by a succession of usually three yelps, also repeated two or three times, is well-known to all who have lived in India; and another call, believed to be an alarm cry, is uttered by a jackal when a tiger or leopard is in the neighbourhood, and probably on other occasions. The animal producing this cry is known as *pheāl* or *phnew* in Northern India, and as *bhālū* or *kol bhālū* in the south; and it is the jackal that is said in Indian folk-lore always to accompany a tiger. There can be very little doubt that some breeds of domestic dogs are derived from jackals, as others are from wolves; and jackals breed freely with dogs.

The two kinds of Wild Dog (*Cyon*) differ in their teeth from wolves and jackals, having two true molars instead of three on each side of the lower jaw; and they are thus, in opposition to the view not uncommonly entertained, less nearly connected

with domestic dogs than jackals and wolves are. They are forest animals of a rusty red colour, and occur in all the well-wooded parts of India and Burma, and even in the highlands of Tibet. They hunt in packs and kill many deer, antelope, wild sheep, hog, &c.; but they rarely attack domestic animals, and have never been known to assail men. Throughout India there is a general belief that wild dogs hunt and kill tigers, but it is still an open question whether the story is credible.

Of the Indian foxes, one very small species (*Vulpes cana*) is found only in Baluchistān, another (*V. ferrilatus*) is Tibetan, a third (*V. leucopus*), a small animal allied to the common European fox, is common in the dry regions of North-western India, while a fourth is a race of the common European fox inhabiting the Himālayas. The fifth, the Indian Fox (*V. bengalensis*), a small greyish animal with a black tip to its tail, is common in all open parts of India proper, from the Himālayas to Cape Comorin and from Sind to Assam.

Martens and weasels are poorly represented, and are unknown in the plains of India and Burma. The Indian Marten (*Mustela flavigula*) inhabits the whole of the Himālayas, and is also found in the higher ranges of Burma and the Malay Peninsula. A dark form occurring on the hills of Southern India is by some authorities regarded as a distinct species (*M. gwatkinsi*). The European Beech Marten (*M. foina*) is met with in Afghānistān, Ladākh, and Kumaun. A polecat (*Putorius larvatus*) has been obtained in Ladākh and Tibet; and another species, the Mottled Polecat (*P. sarmaticus*), which inhabits parts of Eastern Europe and Western Asia, is not rare about Quetta in Baluchistān. Six species of stoats and weasels are also found in the Himālayas, and two of them range into the Burmese hills.

Badgers are represented by two species of the genus *Helictis*, one of which is Himālayan, the other Burmese; by the Indian Ratel (*Mellivora indica*), found in the Indian Peninsula and in parts of Western Asia; and by two species of Hog-badger (*Arctonyx*), which are met with in the Eastern Himālayas, Assam, Burma, and the countries to the east and south-east.

Three kinds of otter are known from India. One of these, having a very wide distribution, appears not to be distinguishable from the Common Otter of Europe (*Lutra vulgaris*); a second of the same size, but with a very differently shaped head, (*L. macrodus*) is also found throughout India and Burma; while the third (*L. cinerea*), the Clawless Otter, is a much smaller species, inhabiting the Himālayas, Bengal, Assam, Burma, Southern China, and the Malay countries, but

only found in Southern India on the Nīlgiris and some other hill ranges. The habits of all are similar. Otters are easily tamed, and are kept by fishermen in several parts of India, as the Bengal Sundarbans and Sind, being used to drive fish into nets.

One of the most interesting members of the Indian Fauna is the Cat-bear or Himālayan Racoon (*Aelurus fulgens*), now generally recognized as belonging to the Racoon family (Procyonidae), the majority of which are American. The *Aelurus* is a brightly rufous animal, measuring two feet from nose to tail, with a tail of about eighteen inches. It is a forest haunter, and is met with in Nepāl, Sikkim, the Eastern Himālayas, and Yunnan; it is, like most Carnivora, nocturnal in its habits, but feeds chiefly on fruits, bamboo sprouts, and roots. It is the only living member of the genus, but within the last few years remains of other species have been found fossil in late Tertiary deposits both in Britain and in Hungary. A curious black and white bear-like animal inhabiting Eastern Tibet (*Aeluropus melanoleucus*) is now ascertained to be a second Asiatic member of the Racoon family.

The last family of the Carnivora is that of the bears (Ursidae), with four Indian representatives. A variety of the European Bear (*Ursus arctus*), sometimes distinguished as the Isabelline Bear, is found in the Higher Himālayas above the forests; the Himālayan Black Bear (*U. torquatus*) is met with at a lower elevation, in the higher forests, occurring not only to the eastward in Assam, Burma, and South China, but also in parts of Afghānistān and Baluchistān. The Malay Bear, a small forest form, with especially arboreal habits, ranges from the Malay countries through Burma to the Eastern Himālayas, and has quite recently been found in Sikkim. The bear of the Indian Peninsula and Ceylon, commonly called the Sloth Bear (*Melursus ursinus*), belongs to a different genus, having much smaller and rather fewer teeth and more powerful claws than the typical bears. It is a smaller animal than the European bear, and is even more uncouth and clumsy. It is black and covered with long coarse hair, but appears nevertheless not to be very sensitive to heat, for it inhabits some of the hottest parts of India. It haunts bush- and forest-jungle and hills, and passes the day in caves, or in shady ravines, or beneath bushes, wandering about at night for food, which consists chiefly of fruit and insects. Among the latter are the combs of the termites or white ants, which the bear digs out of the ground from a depth sometimes of four to six feet. The

holes made, easily recognized by the marks of the bear's claws, afford unmistakable evidence of the animal's neighbourhood. Although generally a timid animal, the Indian bear is occasionally savage and makes unprovoked attacks upon men whom it meets, frequently injuring them about the head and face. Bears when taken young are, as a rule, easily tamed.

Insectivora. The next Order of Mammals comprises the tree-shrews, hedgehogs, moles, and shrews, together with a very remarkable animal of doubtful affinity—the flying lemur. The tree-shrews (Tupaiidae) are only known from the Indo-Malay region; and the typical genus *Tupaia* is represented by one species in the Indian Peninsula, another in Burma and the Eastern Himālayas, and a third in the Nicobar Islands. They are arboreal animals, closely resembling squirrels externally and with very similar habits, but living on insects as well as on fruit. They may at once be distinguished from squirrels by their differently shaped ears, and of course by their teeth.

The hedgehogs (Erinaceidae) are represented by two groups belonging to distinct sub-families. True hedgehogs are found in India proper, but not in the Himālayas or Burma; four species occur in North-western India, and one (*Erinaceus micropus*) in the plains of the Carnatic. The other subfamily (*Gymnurinae*) does not inhabit the country west of the Bay of Bengal or the Himālayas; but one species (*Hylomys suillus*) is found in Burma, and the typical form (*Gymnura rafflesi*) in Southern Tenasserim. Both inhabit the Malay Peninsula and Archipelago. They somewhat resemble large rats, having a pointed head and a naked tail, but their teeth are like those of hedgehogs.

Two moles have been reported from the Himālayas, but the presence of one of these, which is identical with the Common Mole of Europe, needs confirmation. The second kind (*Talpa micrura*) is common in the forests of Nepāl, Sikkim, and the Assam hills, at an elevation of about 5,000 to 8,000 feet above the sea. A third species (*T. leucura*), usually brown in colour with a short white tail, inhabits the ranges south of Assam and the Burmese hills.

Shrews are numerous and ubiquitous. A genus of brown-toothed shrews (*Soriculus*), with three known species, is found in the Eastern Himālayas and Manipur; while the white-toothed division is represented by four genera—*Crocidura*, with thirteen species, very widely distributed; *Anurosorex*, with one kind, found in Assam; and two water-shrews. The best-known

of Indian shrews is the Grey Musk Shrew (*Crocidura caerulea*), widely and unfavourably known as the 'Musk Rat.' It has a peculiar, rather fetid, musky smell, due to the secretion of large glands, one on each side of the body. Its diurnal haunts generally retain the scent, but it does not communicate the smell to anything it merely walks over, although it is commonly believed to do so. It is nocturnal in its habits, and frequents houses at night, feeding on cockroaches and other insects, never on grain or vegetables. Singularly enough, this large grey shrew has not been observed far from human habitations; but a very similar, rather smaller animal of a brown colour (*C. murina*) is common throughout the Indo-Malay region, and Dobson has suggested that the grey shrew may, like the cockroaches on which it feeds, be a semi-domesticated variety—a commensal, in fact, of man.

The two water-shrews live in streams, one (*Chimarrogale himalayica*) in the forests of the Himālayas and Northern Burma, the other (*Nectogale sikhimensis*) in Upper Sikkim at 10,000 to 15,000 feet elevation. The latter has beautiful deep-brown fur sprinkled with glistening white, and the soles of its feet are furnished with suckers.

The so-called Flying Lemur (*Galeopithecus volans*) inhabits the Malay Peninsula and Archipelago, ranging into Siam and Southern Tenasserim. The body is about as large as a rabbit's, but a lateral expansion of the skin begins from the throat, includes all the limbs to the toes, and extends to the end of the tail. This expanded skin serves as a parachute, and enables the animal to glide from tree to tree. The Flying Lemur is said to be purely herbivorous, and is by many naturalists regarded as forming an Order distinct from the Insectivora.

No less than ninety-five species of bats were enumerated from within Indian limits when the mammalian section of the *Fauna* was published in 1891, and two or three have since been discovered. Eleven of these belong to the Pteropodidae or fruit-eating bats, the largest of which are known as flying foxes. One of these (*Pteropus edulis*) is the largest bat known, having an expanse of wings of fully five feet; it inhabits the Malayan Peninsula and Archipelago, the Andaman and Nicobar Islands, and parts of Southern Tenasserim. The common Flying Fox of India and Burma (*P. medius*) measures about four feet across the expanded wings, and is very common in many parts of the country. These bats Chiroptera.

remain hanging in trees during the day, many hundreds often occupying one particular tree, and fly off singly, not in flocks, each evening, in search of food, which consists entirely of fruit. The other fruit-eating bats are smaller.

The insectivorous bats belong to four distinct families—the Rhinolophidae, which have a nose-leaf consisting of a peculiar series of foliaceous skin-processes arranged more or less in the form of a shield around the nostrils, but want the tragus, a lengthened process arising inside the margin of the ear; the Nycteridae, which have a small nose-leaf and also a tragus; and the Vespertilionidae and Emballonuridae, which have a tragus but no nose-leaf. Most of the species are rare, the forms most commonly met with being a yellowish brown bat (*Nycticejus* or *Scotophilus Kuhli*), and a very small species of Pipistrelle (*Vesperugo* or *Pipistrellus abramus*); and one reason why these two are so often seen is that they appear on the wing rather early in the evening. The species of *Megaderma*, belonging to the Nycteridae, have a peculiar dentition; they feed on other bats, and also on frogs. The remainder of the species are insectivorous.

Rodentia. This is another large Order of small animals, comprising squirrels, marmots, rats and mice of various kinds, porcupines, and hares, all distinguished by a peculiar dentition with two large chisel-shaped incisors in the front of each jaw. As many as 106 species were known from the Indian area in 1891, and seven species have since been added, so that considerably more than a quarter of the Mammals found in India and its dependencies belong to the present Order.

Indian squirrels belong to several types. There are no less than three different genera of flying squirrels, which have their limbs connected by a membrane or parachute to enable them to glide from tree to tree, and are distinguished from other squirrels by being nocturnal. One of these, the Woolly Flying Squirrel (*Eupetaurus cinereus*), an inhabitant of Tibet, is very imperfectly known; but the members of the genera *Pteromys* and *Sciuropterus* are generally distributed in all well-wooded parts of India; the majority of them, however, inhabit the Himālayas or Burma. The ordinary squirrels are now divided into three groups, one of which, constituting the genus or sub-genus *Ratufa*, is represented in the forests of the Indian Peninsula by the Large Indian Squirrel (*S. indicus*), a very beautiful kind, chestnut and black above and buff beneath; by the Large Malay Squirrel (*S. bicolor*),

black above and buff beneath, in the Himālayas and Burma; and by a third kind, the Grizzled Indian Squirrel (*S. macrurus*), in Southern India and Ceylon. All these vary much in colour. The sub-genus *Sciurus*, as restricted, is wanting in India proper and Ceylon, but is represented by a large number of species, varying greatly in coloration, in the Eastern Himālayas and Burma. The third section (*Funambulus*) consists principally of striped squirrels, less arboreal than the others, and less restricted to high forest. Of these the best known is the common so-called Palm-Squirrel (*Sciurus vel Funambulus palmarum*), which is a familiar inhabitant of gardens and groves near human habitations, and is often seen feeding on the ground under trees. The name 'palm-squirrel' is misleading, as this animal is far more frequently seen about mangoes, banyan, or pipal trees than on palms. The members of this group are not all striped; one (*S. locria*), inhabiting the Eastern Himālayas and Assam hills, so closely resembles *S. locroides*, a typical squirrel found in the same forests, that the skins of the two are not easily distinguished. On the other hand, some very small striped typical squirrels (*S. macclellandi*) are common in the forests of the Himālayas and Burma.

Of marmots, which are nearly allied to squirrels, three species are found in the Higher Himālayas and Tibet. Two of these (*Arctomys himalayanus* and *A. hodgsoni*) are of a greyish tawny colour and differ chiefly in size; but the third, which occurs in Northern Kashmīr, is orange tawny in hue, and has a comparatively long tail, hence its name (*A. caudatus*). It is large, measuring about three feet, of which the tail forms a third.

The jerboa family (Dipodidae) is represented by a single species (*Alactaga indica*), belonging to a genus common in Central Asia. Despite its name, this species is not Indian; it is found around Quetta in Baluchistān, but not farther to the eastward. The next animal to be noticed, the Malabar Spiny Mouse (*Platacanthomys lasiurus*), has long been regarded as an ordinary rat, but has recently been referred by Mr. Thomas, as it was by its original discoverer, Blyth, to the dormouse family (Gliridae). It is not unlike a dormouse in both coloration and form, and it has a similar bushy tail, but the fur is mixed with spines. It lives on trees in the Anaimalai and Travancore hills.

The rats and mice (Muridae) comprise in India three subfamilies: the gerbils, the true mice and rats, and the voles

and hamsters. The gerbils (*Gerbillus*) are unknown in the Himālayas and Burma; but one species (*G. indicus*) occurs throughout India and Ceylon, and four others are met with in Sind, Baluchistān, and the Punjab. All are graceful, active creatures, with hairy tails tufted at the end. The Indian Gerbil, known in Northern India as *harna mus* or Antelope Rat, is one of the species that occasionally increase greatly in numbers and destroy the crops. It is nocturnal; but another kind (*G. hurrianae*), which swarms in the Indian desert in Sind, Rājputāna, and the Punjab, is diurnal in its habits. It is characteristic of the Aryan people inhabiting Northern India that this animal, which is purely frugivorous, is not used as food, although the common Indian species and other rats are eaten by some of the tribes in Southern India, especially by the Waddas or tank-diggers.

The mice and rats proper comprise three arboreal genera, all of which are Burmese, while only one (*Vandeleuria oleracea*) is found in India. This, a long-tailed mouse of light chestnut-red colour, makes a grass nest in which it rears its young on a bush, tree, or bamboo. The genus *Mus* comprises twenty-three or twenty-four Indian species. Of these the most important are the common Indian Rat (*Mus rattus*), of which the European Black Rat is a variety; the Brown Rat (*M. decumanus*), and the domestic mice. The Common Rat (*M. rattus*) is clearly indigenous, and is found everywhere in forest and cultivated ground, as well as about houses; while the Brown Rat, the pest of the world, is an immigrant, for it is confined to seaports and towns on the principal lines of traffic. House mice are of two kinds: one, a variety of the common *M. musculus* of Europe, is generally distributed throughout India and Burma, while the rather shorter-tailed and more brightly coloured Persian House Mouse (*M. bactrianus*) occurs in North-western India. In Burma the rat commonly found about houses is *M. concolor*, a smaller species than *M. rattus*. One other kind, the *metād* or Soft-furred Field Rat (*M. mettada*), peculiar to the Peninsula of India, requires notice on account of its becoming at times, like *Gerbillus indicus* in India, and like some species of vole in Europe, a pest on account of its numbers and the destruction it causes to the crops.

The Indian Mole-rats and Bandicoots form the genus *Nesocia*, distinguished by robust form and in some cases by large size. The Common Mole-rats (*N. hardwickii* and *N. bengalensis*) are about as long as a black rat, but stouter, and they throw up, beside the holes they make in fields and

banks, small heaps of earth, which have erroneously been attributed to moles; while the Bandicoots (*N. bandicota* of the Indian Peninsula and *N. nemorivaga* of Bengal, the Eastern Himālayas, and Burma) are very large rats, *N. bandicota* weighing as much as 2½ to 3 lb. and measuring 12 to 15 inches without the tail, which is nearly as long. The name bandicoot is a corruption of the Telegu *pandi-koku* or 'pig rat,' a term conferred because this rat is said to grunt like a pig. The North African and Western Asian Spiny Mouse (*Acomys dimidiatus*) has been obtained in Sind; and a blunt-headed yellowish brown bush rat with coarse hair (*Golunda elliotti*) is found throughout the Peninsula and Ceylon, where it proved at one time very destructive to coffee trees.

About a dozen kinds of Vole (*Microtus* or *Arvicola*) are found in the Himālayas and Tibet, most of them being inhabitants of Kashmīr or Ladākh. One species only, of a peculiar section, is met with in the Eastern Himālayas, and one in the Kakhyen hills north of Burma. A species of *Ellobius*, a mole-like rodent allied to the Voles, has been obtained at Quetta. Three kinds of Hamsters (*Cricetus*) of an ashy grey colour have been brought from Gilgit.

The Bamboo-rats (*Rhizomys*), are stoutly-built animals, with cylindrical bodies, short limbs, large claws, and rudimentary tails, belonging to the family Spalacidae, the members of which are sometimes called 'rodent moles.' Three or four kinds of Bamboo-rat, of which the largest is the size of a rabbit, inhabit the Eastern Himālayas, Assam, and Burma.

Four Porcupines occur in our area. The Indian Porcupine (*Hystrix leucura*) inhabits India with Ceylon, and ranges into Western Asia. Two other species of *Hystrix* and one of the brush-tailed porcupine *Atherura* (of which another species is West African) are found in the Himālayan forests and in Burma.

The Hares and Pikas form a group which differ considerably in structure from other rodents. Hares are found in most of the open parts of the Indian area, but not in forest. Two species, one northern (*Lepus ruficaudatus*) and one southern (*L. nigricollis*), inhabit the Indian Peninsula; another (*L. dayanus*) occurs in Sind; a fourth (*L. peguensis*) in Burma; three kinds are found in the highlands of Tibet and on the Himālayas above the forest; and one species, the Hispid Hare (*L. hispidus*), is met with at the base of the Himālayas from Gorakhpur to Upper Assam. This last is a little-known species, and is said to burrow. The Pikas or Mouse-hares

(*Lagomys*) are considerably smaller than a rabbit, and are chiefly confined to Central and Northern Asia. Of five kinds occurring within Indian limits, four inhabit the Higher Himālayas and Tibet, and one is found in the neighbourhood of Quetta.

Ungulata. To the next Order belong elephants, horses, rhinoceros, tapirs, oxen, antelopes, goats, sheep, deer, camels, and swine, besides several generic forms not now found in India. Some of these, however—for instance species of giraffe and hippopotamus—inhabited the country in past times. All the most valuable domestic animals are Ungulates.

The Indian Elephant, one of only two existing species of the Proboscidea, of which no less than seventeen extinct kinds flourished in India in the later Tertiary times, differs widely from all other Ungulates. 'The beast that hath between his eyes a serpent for a hand,' although specialized to an extraordinary degree, so much so that its gait, its method of feeding, and its dentition are quite peculiar, is nevertheless in many respects inferior in organization to other members of the Order to which it is assigned. The numbers of the Indian elephant have decreased greatly in India and Ceylon during the course of the last century, though east of the Bay of Bengal the great beast is more common. Elephants are still found wild in places along the base of the Himālayas, as far west as the Dehra Dūn; a few are met with in parts of the great forest tract east of long. 80° E. between the Ganges and the Kistna; and a larger number in the wild hill ranges that extend from Mysore to Cape Comorin. They generally live in herds, the males, as with other Ungulates, being often found solitary; and they usually haunt forest, and live on grass and bamboos, wild plantains (*Musa*), and the leaves and bark of particular trees, especially of kinds of *Ficus*. As a rule elephants are timid inoffensive animals, but solitary males, known as 'rogues,' are sometimes savage and cause many deaths of men and animals. In India, elephants very rarely breed in confinement, though they often do so in parts of Burma and Siam. The greater number by far of the tame animals belonging to the Government of India, to native princes, and to private individuals, have been caught and tamed when adult. As a rule elephants are captured in stockades (*kheddas*) into which whole herds are driven, a few are caught in pitfalls, others are run down and noosed by men riding fast tame animals.

Wild horses, rhinoceros, and tapirs are not widely distributed in India and Burma. They form the group of odd-toed

or Perissodactyle Ungulates. The only wild horses or asses are the *ghorkhar* of Western India and Baluchistān, found in herds in the Indian desert in places from Cutch to Bīkaner, and also west of the Indus near Mithankot; and the *kiang* of Tibet. These appear to be merely varieties of one species (*Equus hemionus*). Of rhinoceros three kinds are met with, two of which are one-horned, one two-horned. Of these the largest is the Great Indian Rhinoceros (*R. unicornis*), still inhabiting Assam and found in very small numbers in the Nepāl tarai, but formerly occurring along the base of the Himālayas to Peshāwar, where in the early part of the sixteenth century it was hunted by the Emperor Bābar. It lives in high grass as a rule. The second one-horned species, often called the Javan Rhinoceros (*R. sondaicus*), occurs in the Bengal Sundarbans, in Eastern Bengal, and locally through Burma to the Malay countries. It is rather smaller than *R. unicornis*, and may be recognized by different markings on the epidermis and by the great folds of the skin being differently arranged. The third kind, the two-horned *R. sumatrensis*, is the smallest of the three, and has been met with from Assam, where it is rare, to Borneo, being rather common in Tenasserim. The Malay Tapir is only found within our limits in Southern Tenasserim south of about 15° N. lat.

The even-toed or Artiodactyle Ungulates are much more numerous. Of wild cattle alone no fewer than five species are met with in different parts of the area. Of these, one, the Wild Yak (*Bos grunniens*), is peculiar to the Tibetan plateau, and only just comes within Indian limits in the Kashmīr territories, but tame yaks are kept throughout the Higher Himālayas. The Wild Buffalo (*Bos bubalus*) is met with in Assam, Bengal, and Orissa, and here and there in the forest country to the westward as far south as the Kistna river; it is also common in the lower parts of Ceylon, being chiefly found in grassy plains near water and often in marshes. The Gaur (*Bos gaurus*), the Gayāl (*B. frontalis*), and the Tsine or Banteng (*B. sondaicus*) form a particular group of typical oxen, distinguished by flattened horns, a high dorsal ridge terminating about half-way down the back, and peculiar coloration, very dark and often almost black on the upper parts, with the legs white from above the knees and hocks. In the Tsine the cows and young are reddish, in the other kinds dark-brown; the white too extends in the Tsine up the inside of the legs and to the buttocks. The Gaur (bison of Anglo-Indian sportsmen) is a magnificent animal, almost the finest, if not actually

the grandest, of living bovines. Large bulls sometimes measure over six feet in height at the withers, whilst their horns are occasionally each three feet long and as much as eighteen to twenty inches round the base. Cows are smaller. This noble wild bovine is found in all the great hilly forest tracts of India, Burma, and the Malay Peninsula; but owing to the extension of cultivation and the more general use of guns its numbers in India are rapidly diminishing, and in many places it must soon, unless preserved, completely disappear. The Gayāl or Mithan is known only in a domesticated or semi-domesticated state. It is thus kept by several tribes north and south of the Upper Assam valley, but the original wild animal has never been satisfactorily identified. Some writers regard the Gayāl as a domesticated race of the Gaur, which inhabits the same tract, but the differences in the form of the skull and horns are opposed to this view. The Tsine or Banteng is smaller, of rather slighter build than the Gaur, and appears to be less of a hill animal, being found chiefly in grassy plains. It is met with locally throughout Burma and to the southward as far as Java and Borneo, but the Burmese race is said to differ somewhat in coloration from the Malay. This animal is domesticated in Java. Both the Yak and the Buffalo are domesticated. Tame yaks are kept only at considerable altitudes in the Himālayas and in Tibet; tame buffaloes are common throughout the plains of India and Burma. They are chiefly kept in India as milch cattle, though they are also used for draught and for the plough, and in some cases as baggage animals. In Burma, where milk is not used, a very fine race of buffaloes exists, especially in Pegu. Another very fine breed is that owned by the people of the Toda tribe on the top of the Nīlgiri Hills in Southern India.

The common humped cattle of India (*B. indicus*) belong to a perfectly distinct species from European cattle (*B. taurus*). The two kinds differ in structure, coloration, markings, habits, and voice. The prevailing colour of *B. indicus* is a pearly grey with a few black markings, especially on the fetlocks. The origin of the humped cattle is quite unknown; no similar animal exists now or is known to have existed in former times in a wild state, although common cattle, in India as elsewhere, have run wild occasionally. Humped cattle are found domesticated throughout Southern Asia and in Tropical Africa. The two species of cattle breed together, or with the yak and the gayāl, never with the buffalo.

Wild sheep are found within Indian limits in the Himālayas,

and in hilly parts of the Punjab and Sind. The Great Tibetan Sheep (*Ovis hodgsoni*), an animal standing from 3½ to 4 feet high at the shoulder, and with very massive horns in the male, and the Great Pāmir Sheep (*O. poli*), which, although slighter and smaller than its Tibetan ally, carries huge spiral horns sometimes measuring more than six feet apiece round the curve, only just appear within the boundary of British India. The Tibetan sheep has long been called *Ovis ammon*, but that name properly belongs to an even larger kind inhabiting the Altai Mountains in Siberia. The remaining two species, the *uriāl* or *shā* (*Ovis vignei*) and the *bharal* (*O. nahura*), have stronger claims to be included in the Indian list. In *O. vignei* two varieties are comprised: the typical upland form or *shā*, which is larger, has slightly thicker horns, and is found in the Upper Indus Valley and parts of Afghānistān; and the *uriāl* of the Punjab Salt Range, and *koch* or *gad* of the Sulaimān Range and Sind hills. By some the two are regarded as distinct, but they differ very little and pass into each other, although the Sind sheep is met with close to the sea-level and the Ladākh *shā* at 12,000 to 14,000 feet above the sea. The *bharal* is met with throughout the Higher Himālayas above the forest limit, and is in both structure and habits a link between sheep and goats. Like the latter it often takes refuge in cliffs and rocky scarps, while the true sheep keep to plains or moderate slopes.

The Indian wild goats are five in number, of which three belong to the genus *Capra* and two to *Hemitragus*. Like the sheep they are chiefly but not exclusively Himālayan, one species of *Hemitragus* inhabiting Southern India. The members of the genus *Capra* are the Asiatic Ibex (*Capra sibirica*), the Mārkhor (*C. falconeri*), and the Persian Wild Goat (*C. aegagrus*). The Asiatic Ibex is widely distributed on the mountains of Central Asia, and is found in the Higher Himālayas as far east as Garhwāl, but not, it is said, east of the Sutlej drainage area. The Asiatic differs from the European ibex by the shape of the horns and the presence of a distinct beard in the male; but there is some variation in the horns and more in the coloration of the fur in different Asiatic ranges. The colour varies also with the time of year, age, and sex. The Persian Wild Goat is found throughout South-western Asia, its eastern limit being in the Sind hills, where it is often called the 'Sind ibex.' It has the horns compressed and sharply keeled in front. This animal is the wild stock, from which tame goats are principally derived. The Mārkhor, the finest of all wild goats, is found

in the hill ranges north and south of Kashmīr, in parts of Afghānistān, and in the Sulaimān and neighbouring ranges west of the Punjab as far south as Quetta, where it meets the Persian wild goat. It inhabits steep hill slopes at a moderate elevation, below those on which ibex are found. Mārkhor vary greatly, and the shape of the horns is very different in Kashmīr from what it is in the Sulaimān range. In the Pīr Panjāl, south of Kashmīr, the spiral is open, and even more so in Astor; while in the range to the west of the Punjab, the horns are straight with their anterior and posterior keels wound spirally around them. Heads from the neighbourhood of Kābul are, intermediate in character. The two species of *Hemitragus*, which possess much smaller horns than *Capra*, are the Tahr (*H. jemlaicus*), found throughout the Himālayas, and the Nīlgiri Wild Goat, or 'ibex' of European sportsmen (*H. hylocrius*), found on the ranges of Southern India in the neighbourhood of the west coast, from the Nīlgiris to Cape Comorin. The only other species of the genus that is known occurs in Southern Arabia. All these goats occur in small herds, the males being frequently solitary, and they keep chiefly to crags and precipitous cliffs.

The goat antelopes are nearly allied to the true goats, from which they are distinguished by more rounded horns and by the absence of the peculiar strong odour characteristic of male goats. They have a very different distribution, for they are wanting in Europe, Western Asia, and the Indian Peninsula, but represented in the Himālayas, Burma, China, Japan, the Malay countries, and in North America. The Himālayan Serow (*Nemorhaedus bubalinus*) and the Gural (*Cemas goral*) are members of this group. The Serow inhabits the Himālayan forests from Kashmīr to the Mishmi Hills at moderate elevations; it is also found in the Assamese and Burmese hills. It is, as a rule, a solitary animal. Several races have been distinguished, varying in colour from rufous brown to black, but it is doubtful whether there is any constant difference. The Gural is a much smaller animal than the Serow, being about the size of a roe-deer, and it inhabits rugged grassy slopes in the forest area, usually in small parties not exceeding six or eight in number. It is found throughout the Himālayas, has been reported from the ranges south of Assam, and quite recently has been discovered in Upper Burma.

The true antelopes form a very important portion of the Indian Mammalia, because three genera out of the four occurring in the Peninsula are peculiar to the area and no

antelopes are found elsewhere in the Indo-Malay region. These three Indian antelopes are the Nīlgai (*Boselaphus tragocamelus*), the Four-horned Antelope (*Tetracerus quadricornis*), and the Indian Antelope or 'black buck' (*Antelope cervicapra*). All these inhabit a large part of India, and the Hindus themselves sometimes define their country (Hindustān) as corresponding with the range of the Indian antelope. This antelope is found in suitable localities, chiefly open plains with grass of moderate height, from the Indus to Assam, and from the base of the Himālayas to the neighbourhood of Trichinopoly. Formerly it was far more abundant, and in the first half of the nineteenth century it was seen occasionally in vast herds 8,000 to 10,000 in number; but its numbers have been greatly reduced since rifles have become common. The Nīlgai is an inhabitant of open forest more often than of grassy plains, though in places it haunts cultivated tracts, and when numerous it is met with in herds; while the Four-horned Antelope is chiefly found in hilly countries covered with brushwood or forest, and is usually solitary or in pairs. A variety with only two horns, the anterior pair not being developed, is said to be common locally in the Madras Presidency, and certainly adult two-horned individuals are occasionally found, but all young males possess only the posterior pair. In the Nīlgai, Four-horned, and Indian Antelopes the females are hornless. The Tibetan Antelope (*Pantholops hodgsoni*), with fine sub-lyrate horns, is found only on the higher Tibetan plateaus, and is said never to descend much below about 15,000 feet. It occurs in the higher portions of Ladākh. Three true gazelles are met with within Indian limits, but two of these only just come within the boundary. These are the Tibetan Gazelle (*Gazella picticaudata*), peculiar to the Tibetan plateau; and the Persian Gazelle (*G. subgutturosa*), which has a wide range in Persia and Turkistān, but is known within Indian limits only about Pishīn, north of Quetta. It probably inhabits the higher parts of Baluchistān. Both these species, like *Pantholops* and *Antelope*, have hornless females, but in the Indian Gazelle (*G. bennetti*) the females have small horns. The Indian Gazelle is found in North-western, Western, and Central India, as far east as Palāmau and as far south as western Mysore. It usually occurs singly or in small parties, and is called *chinkāra* in Hindī, while the antelope is *hiran*, a name often applied loosely, like the English 'deer,' to various ruminants.

The deer family (Cervidae), though less numerous than the bovines, are abundantly represented. The first to be mentioned is the Muntjac or Barking-deer (*Cervulus muntjac*), a

small kind, deep-chestnut in colour, the males bearing short horns on bony pedicels as long as the horns themselves or longer. This is an animal of hill forest, found in suitable places throughout India, Ceylon, and Burma, and on the slopes of the Himālayas up to 5,000 or 6,000 feet. Its name of 'barking-deer' is derived from its call, which resembles the bark of a dog. A second species (*C. feae*) has been obtained on Muleyit mountain, west of Moulmein. The genus *Cervus* is represented by six different species. One of these belongs, like the European Red Deer and the American Wapiti, to the Elaphine group, distinguished among other characters by having two tines, the brow and bez tines, near the base of each horn. This fine deer, the *hangal* or Kashmīr Stag (*C. cashmirianus*), inhabits the pine forests of Kashmīr between 9,000 and 12,000 feet above the sea in summer, coming lower in winter. The other Indian deer belong to the Rusine section, and have a brow but no bez tine. The *bārasingha* or Swamp Deer (*C. duvauceli*) has, when full-grown, five or six tines on each antler, all but one on the terminal bifurcated portion. It inhabits open grass plains in Northern India, from Upper Assam to Sind, and as far south as the Godāvari, but is very locally distributed. The Brow-antlered Deer or *thamin*, which replaces the *bārasingha* in Manipur and Burma, has a peculiarly curved long brow tine: it is chiefly found on flat alluvial ground in the Irrawaddy Valley and to the eastward in Cambodia and Hainan. The finest of Indian deer, with exception of the Kashmīr stag, is the *sāmbar* or *jarau* (*C. unicolor*), which is found almost throughout the Indo-Malay region wherever there is hilly or undulating country covered with forest. It occurs on all the hill groups of India, ascends the Himālayas in places to 9,000 or 10,000 feet, and is met with up to the summits of the ranges in Southern India and Ceylon. The next species to be mentioned, the Spotted Deer (*C. axis*), is certainly the most beautiful of Indian deer and perhaps of the whole family. It is smaller than the four species already noticed, and rufous-fawn in colour spotted with white. It retains its white spots throughout the year, in this differing from the Hog Deer. The Spotted Deer is met with at the base of the Himālayas but does not ascend the hills like the *sāmbar*, and it ranges throughout the Indian Peninsula and Ceylon but is not found east of the Bay of Bengal. Its usual haunts are brushwood and thin forest, and especially bamboo jungles in the neighbourhood of water. Spotted Deer are more gregarious than other Indian species, and occasionally associate in large

numbers. The last deer on the list is also the smallest of the genus, and it bears the smallest horns. This is the Hog Deer (*C. porcinus*), which inhabits the alluvial flats of the Indo-Gangetic plain from Sind to Assam, and is also found abundantly in similar localities in Burma. It does not occur in the Indian Peninsula generally; and, though it is found in part of south-western Ceylon, its presence there is due to its having been introduced by man. It is a brown animal, spotted in summer but not in winter, and is not gregarious.

The only other Indian representative of the Cervidae, if it belongs to the family, is the hornless Musk Deer (*Moschus moschiferus*), which is common in the Higher Himālayas and in parts of Central Asia. It is a dark-brown animal, about the size of a roe-deer, with coarse brittle hair, and is chiefly known as the source of musk, which is the secretion formed in a glandular sac on the abdomen of the male. In winter about an ounce of musk is obtained from each male animal. The flesh has no musky flavour.

The Chevrotains (Tragulidae) differ greatly from true deer in structure, but resemble them in form, and like the Musk Deer are hornless. All are small, some very small. One species, the Indian Chevrotain or Mouse Deer (*Tragulus meminna*), inhabits Ceylon and the Indian Peninsula, but is not known north of the Narbadā; while two species (*T. javanicus* and *T. napu*) occur in Southern Tenasserim and range into Malaysia. The Indian Chevrotain and *T. napu* are about a foot high at the shoulder, *T. napu* being the larger; the little *T. javanicus* is considerably less. All inhabit dense thickets in forest country.

Three different pigs belong to the Indian Fauna. The Indian Wild Boar (*Sus cristatus*) stands higher on its legs than the European animal, and is much less shaggy; it has a more developed crest or mane, and the molar teeth exhibit well-marked differences. The common tame pig of India is doubtless descended from the wild animal and certainly breeds with it. Wild swine occur everywhere in India and Burma, and are often as common in cultivated land as in wild forest. No animals do more damage to crops. Spearing wild hog from horseback, or 'pig-sticking,' as it is called in India, is the favourite sport of the country, and owes its attraction to the extraordinary courage of the wild boar. The Andaman Pig (*S. andamanensis*) is a much smaller kind, peculiar to the Andaman Islands; and a still smaller species, not more than a foot high, known as the Pigmy Hog (*S. salvanius*), is only known from the grass jungles of

the tarai at the base of the Himālayas in Nepāl, Sikkim, and Bhutān. A wild pig found in the Nicobars has just been named *S. nicobaricus*, but is probably a variety of the Andaman species.

Cetacea. Several kinds of whales and porpoises inhabit the seas around India, and two species are found in some of the larger rivers. Though no Right Whale (*Balaena*) has been seen in Indian waters, four kinds of Fin Whale (*Balaenoptera*) have been more or less clearly indicated, although none of them has been thoroughly identified. One of these, which has received the name of *B. indica*, is 80 or 90 feet in length, or as large as the *B. sibbaldi* of Northern seas, which exceeds in size any other known animal, extant or fossil. This great whale is not rare off the Baluchistān coast. A kind of hump-backed whale (*Megaptera*) also appears to have been seen near the coast of India on more than one occasion. The Sperm Whale (*Physeter macrocephalus*) has been hunted in the Bay of Bengal, and the Small Sperm Whale (*Cogia*), the size of a porpoise, was obtained by Elliot at Vizagapatam. Porpoises and dolphins abound, and fifteen species have been recorded from Indian seas, varying in size from the little Indian Porpoise about four feet in length to the Indian Pilot Whale, a representative of the Caing Whale of European seas, measuring over fourteen feet. The two forms that particularly deserve notice are those inhabiting the rivers. In the Irrawaddy from below Prome to above Bhamo there is found a blunt-nosed porpoise (*Orcella fluminalis*), about seven to eight feet long, closely allied to a species (*O. brevirostris*) that inhabits the Bay of Bengal. This Cetacean is not known to occur in any other river. A far more interesting kind is the Gangetic Dolphin or *sūsū* (*Platanista gangetica*), living in the Indus, Ganges, and Brahmaputra and their tributaries; for the family to which it belongs (Platanistidae), once probably widely spread, has only three surviving representatives: one (*Inia*) in the River Amazon, a second (*Pontoporia*) in the Rio de la Plata estuary, and the Indian type. This last is provided with a long compressed beak-like rostrum, and is blind, having only minute rudimentary eyes without a crystalline lens. It is quite confined to the rivers, never, so far as is known, entering the sea.

Sirenia. The Dugong (*Halicore dugong*) inhabits the shores of the Indian Ocean from East Africa to Australia, and has been found on the coasts of Malabar, Ceylon, the Andaman Islands, and the Mergui Archipelago. Formerly it was more common; but as it yields excellent meat and a valuable oil, and is also,

by all accounts, tame, stupid, and easily killed, it is approaching extermination in Indian seas.

Edentata. The last Order of Mammals is represented in the eastern tropics by the Pangolins (*Manis*), of which three species occur within Indian limits. These are the Indian Pangolin (*M. pentadactyla*), in the Indian Peninsula and Ceylon; the Chinese Pangolin (*M. aurita*), in the Himālayas; and the Malay Pangolin (*M. javanica*), in Burma and other countries to the south-eastward. All are covered with large imbricate horny scales, and resemble a reptile rather than a mammal. They are toothless and live chiefly on ants. The Indian species is popularly regarded as a fish, and one of its vernacular names, *ban-rohu*, means 'jungle carp.'

Birds

The birds of India have been more extensively collected and better observed than any other group of animals, and the number of kinds is so large that only the most conspicuous and important can be noticed here. Of the 1,617 species enumerated in the *Fauna*, 936, or considerably more than half, belong to the Order of Passeres, and of about thirty species added since the Bird-volumes of the *Fauna* were published a large majority are Passerine. No two authors agree as to the classification of the Passerine Order; the system used in the *Fauna* is here followed.

Passeres. The first family (Corvidae) has been divided into three sub-families; one (*Corvinae*) comprising the crows, magpies, jays, nutcrackers, and choughs; the second (*Parinae*), the titmice and their relations; the third, *Paradoxornithinae*. By many writers these three groups are regarded as distinct families.

The common crows, which are ubiquitous in India, are the grey and black Indian House Crow (*Corvus splendens*), which is the common scavenger of the country, abundant in every town and village; and the black Jungle Crow (*C. macrorhynchus*), which keeps chiefly to forests and wild tracts. The former is represented by an allied form, rather darker in colour (*C. insolens*), in Burma. Of the Raven (*C. corax*), one very large race inhabits the Higher Himālayas, and a smaller form, by some regarded as distinct and named *C. lawrencii*, is found in the Punjab, Sind, and Western Rājputāna. The Carrion and Hooded Crows, the Rook and Jackdaw are met with in the North-western Punjab and parts of Kashmīr, but are for

the most part winter visitors. The Common Magpie (*Pica rustica*) is found in Kashmīr, in Baluchistān, and also in Upper Burma, while a black-rumped species (*P. bottanensis*) has been obtained in Upper Sikkim and Bhutān. Long-tailed Blue Magpies (*Urocissa*) and the Racket-tailed Magpies (*Crypsirhina*) inhabit the Himālayas and Burma; Green Magpies (*Cissa*) occur in the same countries and in Ceylon; while the Tree-pies (*Dendrocitta*) are generally distributed. Jays (*Garrulus*) of different species occur in the Himālayas and Burma; two kinds of Nutcrackers (*Nucifraga*) are Himālayan; and in the higher ranges of that chain both the Cornish Chough and the Alpine Chough are found.

Among the Titmice, members of the typical genus *Parus* and of the much handsomer yellow and black *Machlolophus* are found almost throughout the Empire; while species of the Long-tailed Titmouse (*Aegithaliscus*) occur in the Himālayas and in the hill tracts of Burma; and Crested Tits (*Lophophanes*) are common in the Himālayas, chiefly above 6,000 feet elevation. One genus (*Silviparus*) is restricted to the Himālayas and Assam ranges.

The *Paradoxornithinae* are classed among the Corvidae in the *Fauna*, but are by many ornithologists regarded as a section of the next family (Crateropodidae). They are birds varying from the size of a sparrow to that of a thrush, having copious soft plumage, strong legs, and a stout bill resembling a finch's. They are an interesting group on account of their peculiar structure and their distribution, for they are confined to the Himālayas with the hills of Northern Burma and Southern China. The principal genera are *Paradoxornis* and *Suthora.*

The family Crateropodidae (or Timaliidae) is an exceedingly large and varied group, to which eighty-six genera of Indian birds, comprising 253 species, have been referred. Very few, if any, are migratory. About the position and relationships of some of the sub-families, six in number, there is much question, but the typical forms belong to the first two sub-families. Of these the first (*Crateropodinae*) contains the Laughing Thrushes and Babblers or Babbling Thrushes, of which the larger number, including the genera *Garrulax*, *Trochalopterum*, and *Pomatorhinus*, are hill birds chiefly occurring in the Himālayas and Burma, but with representatives in the hills of Southern India and Ceylon; while a smaller section, consisting of the true Babblers, belonging to the genera *Argya* and *Crateropus*, inhabits the Peninsula of India and Ceylon, with a few representatives in Burma, Assam, and the neighbouring countries.

All these birds are excessively noisy chatterers; they are found in small flocks, and keep to bushes or the ground. They are about the size of a thrush, with strong legs, small wings, and rather long tails. One of the best known species is *Crateropus canorus*, the *sāt-bhai* ('seven brothers') of Bengal.

The *Timeliinae* are smaller and rather quieter, but their structure and habits are similar. The majority are but little known. By far the larger number are Himālayan, Assamese, and Burmese; and only one species, the Yellow-eyed Babbler (*Pyctorhis sinensis*), is commonly found throughout the greater part of India and Burma.

The *Brachypteryginae* are less characteristic forms, for some of them resemble thrushes, whilst others are nearer in appearance to wrens. The most important genus referred to the group is *Myiophoneus*, containing the Whistling Thrushes, very dark-coloured birds with the plumage strongly tinged with rich blue. They have a peculiar whistling note, and inhabit the Himālayas and the hill tracts of India and Burma.

The *Sibiinae* are forest birds, often with bright plumage and of small size, and with one exception they are absent from India proper and Ceylon. The exception is the genus *Zosterops*, comprising the White-eye or White-eyed Tits, yellowish or olive green birds, which range almost throughout the tropics of the Old World from Africa to Australia, and are very doubtful members of the present sub-family. *Sibiinae* are abundant in the Eastern Himālayas and Assam ranges.

The *Liotrichinae* chiefly differ from the *Sibiinae* by having the sexes differently coloured. The typical forms (*Liothrix*, *Cutia*, *Pteruthius*, *Mesia*, and *Minla*) are found within our limits only in the Himālayas and the Burmese hills; but the common Iora (*Aegithina tiphia*), and various species of *Chloropsis*, commonly known as 'green bulbuls,' are common birds throughout the Empire. The Fairy Blue-bird (*Irena puella*), of which the male is clad in gorgeous ultramarine plumage (the female is less brilliant), inhabits the evergreen forests of Ceylon, Malabar, the Eastern Himālayas, the Assam ranges, and Burma.

The last Crateropodidine sub-family, Bulbuls (*Brachypodinae*), are short-legged birds, in general about the size of a nightingale or rather larger. Some of them are familiar types, frequenting gardens. The majority of the seventeen genera found within Indian limits are Himālayan or Burmese; but members of the genera *Molpastes*, *Otocompsa*, and *Pycnonotus*, distinguished by having the under tail coverts either crimson or bright yellow,

are the common bulbuls of India. Another genus deserving notice is *Hypsipetes*, dark-coloured, hill-forest birds, with red bills and forked tails, found in the Himālayas and the hills of Burma and South India.

The Nuthatches (Sittidae), small bluish or slatey-blue birds, which climb up the stems of trees or occasionally the surface of rocks, are represented in India by eleven species, which are non-migratory and for the most part of limited distribution; but one or more of them are to be found wherever there are trees, and one species (*Sitta tephronota*) even where there are none, in Baluchistān.

The Drongos (Dicruridae), of which the more common species are generally called 'king-crows' in India, form a well-marked family, having with few exceptions glossy black plumage and long forked tails. There are several genera, the common and familiar 'king-crows,' found in almost every garden, being members of the typical genus *Dicrurus*. Two species, the Larger and Smaller Racket-tailed Drongos (*Dissemurus paradiseus* and *Bhringa remifer*), are handsome birds, with the outer tail feathers greatly prolonged and their shafts bare for some distance, though webbed near the ends. All Drongos hawk insects in the air, and have musical voices; all, moreover, are given to imitating the notes of other birds.

Of the Tree-Creepers (Certhiidae), six species of the typical genus (*Certhia*) occur in the Himālayas, Assam hills, and Northern Burma, and a species of *Salpornis* is found in the forests of the Indian Peninsula. The latter is remarkable, because the only other known species of the genus, a very near ally, is African. The European Wall-Creeper (*Tichodroma muraria*) is a winter visitor to the Himālayas, and occasionally to the plains of Northern India.

Wrens, generally placed in a distinct family (Troglodytidae), are represented by several species belonging to four or five genera in the Himālayas and Burma, but not in the Indian Peninsula. The European Goldcrest (*Regulus cristatus*), which belongs to a separate family (Regulidae), is also Himālayan.

Warblers (Sylviidae) comprise a great number of very small birds, usually with plain plumage; many of them are migratory. Among those generally distributed are Grasshopper Warblers (*Locustella*), Reed Warblers (*Acrocephalus*), Tailor Birds (*Orthotomus*), Fantail Warblers (*Cisticola*), Wren Warblers (*Franklinia* and *Prinia*), and Willow Warblers (*Phylloscopus* and (*Acanthopneuste*). Members of the genera *Hypolais* and *Sylvia*,

allies of the European Whitethroat, Blackcap, and Icterine Warbler, are common in the Indian Peninsula and Ceylon, but wanting to the eastward. The Tailor-birds are well-known from their habit of sewing two leaves together with a piece of grass as a receptacle for their nest.

Shrikes (Laniidae) are common throughout the Empire. Besides the true Shrikes (*Lanius*), the Pied Shrikes (*Hemipus*), Wood Shrikes (*Tephrodornis*), Minivets (*Pericrocotus*), and Cuckoo Shrikes (*Campophaga* and *Graucalus*) are distributed throughout the better-wooded tracts. Some of the Minivets are brilliantly coloured, the males being crimson and black, and the females yellow and black. The Swallow Shrikes (*Artamus*), dull-coloured birds with a peculiar flight slightly resembling a swallow's, are found all over India and Burma.

There are no less than eight species of Golden or Yellow Orioles (Oriolidae) found within Indian limits, many of them local, but some widely diffused. A ninth species (*Oriolus traillii*), inhabiting the Himālayas and Burma, has black and chestnut plumage instead of black and yellow.

The Grackles, Talking Mainas, or Hill Mainas (Eulabetidae), glossy black in colour with rich yellow cheek lappets, are well-known cage-birds with wonderful powers of imitating the human voice. Though often classed with the starlings, they are apparently distinct. Four representative species occur in the hill forests of the Himālayas, India, Ceylon, and Burma.

The Starling family (Sturnidae) contains the true Starlings, the Rosy Pastors, and the Mainas. Of true Starlings (*Sturnus*), six closely allied species are found in Northern India, most of them being migratory. The Rosy Pastor (*Pastor roseus*) is also migratory, but it abounds throughout a great part of the Indian Peninsula in winter, and is notoriously destructive to grain crops, especially to millet. The Mainas are resident and numerous. The Common or House Maina (*Acridotheres tristis*) is a familiar bird around human habitations almost throughout the Empire. The Bank Maina (*A. ginginianus*), the Black-headed Maina (*Temenuchus pagodarum*), the Jungle Maina (*Aethiopsar fuscus*), and the Pied Maina (*Sturnopastor contra*) are all common.

The next family, that of the Flycatchers (Muscicapidae), comprises rather more than fifty Indian species of small size. Though generally distributed, these birds are not of much importance. Perhaps the best-known kind is the Paradise Flycatcher (*Terpsiphone paradisi*), of which the immature birds and females are black and chestnut, while the mature male

has the chestnut replaced by white. The tail in the male is very long, sometimes exceeding a foot in length.

Thrushes and their allies form the family Turdidae, divided into several sub-families. Of these the first is that of the *Saxicolinae*, comprising the Bush-chats or Whin-chats, Stone-chats, and Wheatears, mostly migratory birds, of which several species are winter visitors to Northern India, and a few are more generally distributed. The Redstarts and their allies (*Ruticillinae*) are more numerous, but are chiefly hill birds. The Indian Robins (*Thamnobia*) are, however, common throughout the Indian Peninsula, whilst the Indian Magpie Robin or Dayal (*Copsychus saularis*), and that well-known songster, the Shama (*Cittocincla macrura*), range throughout the greater portion of the Empire, and the Indian Redstart (*Ruticilla rufiventris*) is a winter visitor to almost the whole of India with Assam and Manipur. Other forms are the Forktails (*Henicurus*) and their allies, black and white birds haunting banks of streams in the Himālayas and Burma; the migratory Blue Throats (*Cyanecula*), Ruby Throats (*Calliope*), and several others.

The *Turdinae* comprise the Thrushes and Blackbirds, which are in India almost confined to the hill ranges, the only forms found in the plains being the Migratory Blue Rock Thrushes (*Petrophila*), and some equally migratory Ground Thrushes (*Geocichla*). Of the other two sub-families belonging to the Turdine family, the Dippers (*Cinclinae*) and the Accentors (*Accentorinae*), none of the members range south of the Himālayas, and but few are found away from the higher mountains.

The Ploceidae comprise two sub-families, the *Ploceinae* or Weaver Birds, and the *Viduinae* or Munias, both found throughout the Indian Empire. The Weaver Birds are finch-like, and generally the males are more or less yellow in the breeding season; they make curious flask-shaped grass nests, which may often be seen hanging from trees or bushes, some of them having long tubular entrances. The Munias and Avadavats are even smaller, and comprise several common cage-birds.

The Finch family (Fringillidae) are divided into the Hawfinches (*Coccothraustinae*), True Finches (*Fringillinae*), and Buntings (*Emberizinae*). The Hawfinches or Grossbeaks are scarcely Indian; five species are known from the Himālayas, chiefly from the higher forests; but one of these ranges as far as Manipur and the Burmese Shan States. Among the True Finches the great majority are Himālayan. Bullfinches, a Cross-

bill, Rose Finches of several genera and many of them beautifully coloured, a Goldfinch, two Linnets, a Siskin, a Greenfinch, and several Mountain Finches inhabit parts of the higher ranges, while a single migratory Rose Finch (*Carpodacus erythrinus*) visits India and Northern Burma in the winter. The Yellow-throated Sparrow (*Gymnorhis*), a bird with African affinities, inhabits the Indian Peninsula, and the House Sparrow is found wherever there are human habitations. Three more species of Sparrow are found in Burma; and two others, with the Brambling (*Fringilla montifringilla*) and the Desert Finch (*Erythrospiza githaginea*), are met with in the Punjab or Sind. The Buntings are mostly migratory. Of the fifteen species found within Indian limits the majority are winter visitors to the Himālayas or to North-western India or to both; five are found in the Eastern Himālayas and Burma; one (*Emberiza striolata*) is resident in North-western India; and two migratory birds, the Corn Buntings (*E. melanocephala* and *E. luteola*), are common winter visitors to India, the first being notorious for the ravages it commits in corn-fields. The Crested Bunting (*Melophus melanicterus*), of which the male is a rather handsome bird, black and chestnut, is resident in many parts of India and Burma.

In the Swallow family (Hirundinidae) are included, besides the true Swallows, the Martins (*Chelidon*), Sand Martins (*Cotile*), and Crag Martins (*Ptyonoprogne*). The House Martins are chiefly Himālayan, though stragglers have been found in various parts of the Empire. Sand Martins of two closely allied species are very widely distributed. Crag Martins are met with about cliffs in the Peninsula of India and the Himālayas, but are not known with certainty from Burma. Ten species of true Swallows occur within Indian limits, some of them migratory but the greater number resident. Among them are the common European Swallow (*H. rustica*), a winter visitor everywhere; the Wire-tailed Swallow (*H. smithii*), with the shafts of the outer tail feathers produced beyond the webs; the Indian Cliff Swallow, which breeds on the high banks of rivers in large societies; and several forms of Striated Swallow, with the lower surface streaked.

Pipits and Wagtails combine to form the family Motacillidae, and both comprise many species, and are found almost everywhere. The Larks (Alaudidae) are represented by no less than ten genera, but several of these are very restricted in range. Thus the Desert Lark (*Alaemon desertorum*), an African species is met with in India only on the deserts of the Indus plain.

The Calendra Lark (*Melanocorypha*) does not occur much farther to the eastward, while the Crested Larks (*Galerita*) and the Finch Larks (*Ammomanes* and *Pyrrhulauda*), common in India, are unknown east of the Bay of Bengal. The Eared Larks (*Otocorys*) are Himālayan. Skylarks (*Alauda*) and Bush Larks (*Mirafra*) are met with throughout the Empire.

The Sun-birds (Nectariniidae) are of small size and have long narrow bills. The males of one sub-family (*Nectariniinae*) almost rival the Humming-birds of America in the brilliancy of their plumage, and they are occasionally, though wrongly, called 'humming-birds'. Some of the species are found throughout India and Burma, but more kinds are peculiar to the hill forests. The other sub-family, known as Spider-hunters (*Arachnotherinae*), are rather larger and of a dull olive colour; their bill is longer. They inhabit the Himālayas, Burma, and the hills of Southern India.

The Flower-peckers (Dicaeidae) are small forest birds with a short triangular bill and the edges of both mandibles minutely serrated, as are also those of the Sun-birds. They are pretty generally distributed throughout India, but are more common in the Himālayas and Burma. Some of them have brilliantly coloured males.

The last Passerine family is that of the Pittidae, handsome birds about the size of a large thrush, living on the ground in woods and forests. One species (*Pitta brachyura*) inhabits Peninsular India and Ceylon; three are met with in the Eastern Himālayas; and the number of species increases in Burma, and especially to the southward in Tenasserim.

Eurylaemi. The Broadbills, although nearly allied to the Passeres, are distinguished by anatomical characters. The geographical distribution of the Order is restricted, none being found outside the Indo-Malayan or Oriental region, while within that region species occur in the Himālayas, Burma, Siam and Cambodia, the Malay Peninsula and Archipelago as far as Borneo and the Philippines, but not in the Indian Peninsula or Ceylon. The Broadbills are small forest birds, living in little flocks among high trees and feeding as a rule on insects. Some are very beautifully coloured. Among the most noticeable are the Long-tailed Broadbill (*Psarisomus dalhousiae*), which ranges from Mussoorie in the Western Himālayas to Borneo; two kinds of *Eurylaemus*, found in Burma; the Dusky Broadbill (*Corydon sumatranus*), met with in Tenasserim and the Malay countries; and the grass-green frugivorous *Calypto-*

mena, with the bill almost concealed by the loral feathers, having the same distribution.

Pici. Woodpeckers are very common and conspicuous throughout the Empire, no less than eighteen genera and fifty-five species of true Woodpeckers being found, besides two 'Piculets' (*Picumnus* and *Sasia*) and the common Wryneck (*Iynx torquilla*), which is a winter visitor. The Woodpeckers and Piculets are not migratory. A large proportion of the genera are found, within the area, only in the Eastern Himālayas, Assam, and Burma; others are represented in the hills of Southern India; but the kinds generally distributed throughout India and Burma are not numerous. The two commonest in India are the Golden-backed Woodpecker (*Brachypternus aurantius*) and the Yellow-fronted Pied Woodpecker (*Liopicus mahrattensis*). Several species of Green Woodpeckers (*Gecinulus*), Pied Woodpeckers (*Dendrocopus*), and Pigmy Woodpeckers (*Iyngipicus*) are found in the hill tracts. Among other interesting forms are the Great Slaty Woodpecker (*Hemilophus pulverulentus*) of the Himālayas and Burma; the Black Woodpeckers (*Thriponax*), represented within our limits only in Burma and Malabar; and the three-toed *Tiga*, which is similarly distributed, but also represented in the Himālayas.

Zygodactyli. This Order, which resembles the Woodpeckers in having two toes, the first and fourth, directed backwards, but differs in several structural characters as well as in appearance and habits, comprises two families represented in India, the Honey Guides (Indicatoridae) and the Barbets (Capitonidae). Only one species belongs to the first, and that is a very rare Himālayan bird (*Indicator xanthonotus*); but it and a Malayan species are closely allied to the African birds so well known for the assistance they afford in the discovery of bees' nests. Barbets are fruit-eating birds; and all Indian and Burmese species, with one exception, are more or less grass-green in colour. The exception is a Malayan bird (*Calorhamphus hayi*), found in Tenasserim. Among the other Indian Barbets are birds as large as a jay belonging to the genus *Megalaema*, with one Himālayan and one Burmese and Chinese species, and smaller forms representing the genera *Thereiceryx*, *Cyanops*, and *Xantholaema*, some of which are found in all well-wooded parts of the Empire. These Barbets have peculiar calls of one, two, or three syllables repeated in a monotonous manner for some minutes; the best-known species being the little 'Coppersmith' (*Xantholaema haematocephala*), found in most Indian gardens, and recognized by its monosyllabic metallic call.

Ansiodactyli. Next we have a somewhat heterogeneous group, comprising the Rollers (*Coraciae*), Bee-eaters (*Meropes*), Kingfishers (*Halcyones*), Hornbills (*Bucerotes*), and Hoopoes (*Upupae*). All are well represented throughout India.

The Indian Roller (*Coracias indica*), commonly called the 'blue jay' (it is not related to the true Jays), is resident throughout India and Ceylon, being replaced by a nearly allied species (*C. affinis*) in Burma. It is a familiar bird, conspicuous by its blue plumage, and is often seen in gardens and orchards, where it hawks insects, and sometimes feeds on lizards or mice. It is associated with the worship of Siva. The European Roller (*C. garrula*), a migratory species, visits North-western India during migration and breeds in Kashmīr and Central Asia. The Broad-billed Roller (*Eurystomus orientalis*), a forest type, is found in the Himālayas, Burma, the Malabar forests, and Ceylon.

The Bee-eaters are slender-billed birds with, for the most part, green plumage. One of the smallest species (*Merops viridis*) is common almost throughout the Empire, except in the Himālayas. Besides several other species of *Merops*, the two kinds of *Nyctiornis*, rather larger forms, known as the Blue-bearded and Red-bearded Bee-eaters, should be mentioned: the former occurring in the Himālayas, Burma, the Malabar forests, and near Sambalpur in the Central Provinces; the latter in Tenasserim and the Malay Peninsula.

Of Kingfishers eighteen species are recorded within Indian limits. The principal are the Common Kingfisher (*Alcedo ispida*), a small variety of the European bird, which is generally distributed; the Indian Pied Kingfisher (*Ceryle varia*), a black and white species closely allied to the South European and African *C. rudis*, also met with throughout the Empire; a large form of *Ceryle*, found in the Himālayas; and the equally large blue and buff *Pelargopsis*, three species of which occur on the sea-coast and along estuaries and large rivers. The White-breasted Kingfisher (*Halcyon smyrnensis*), which is chiefly insectivorous, is common throughout India, Ceylon, and Burma.

Hornbills, sometimes wrongly called Toucans, are rather typical Indian birds, although the only kind found generally in the Peninsula is the Common Grey Hornbill (*Lophoceros birostris*), a small species. Two other forms of the same genus are met with in Malabar and Ceylon and others in Africa, but none occur in the Himālayas or in Burma, where, however, there are numerous kinds of the great Black and White Horn-

bills, belonging to the genera *Dichoceros*, *Rhytidoceros*, and *Aceros*, birds $3\frac{1}{2}$ to 4 feet in length; and other genera again are found in Southern Burma. The largest of all (*Dichoceros bicornis*), the *garuda* of many Hindus, with a broad concave casque, is also met with in the forests of the Western Ghāts; and the smaller Pied Hornbills of the genus *Anthracoceros* are represented in the forests of South-western Bengal, as well as those of Malabar and Ceylon, and in the Himālayas and Burma. All are mainly frugivorous, and have a remarkable habit of the female remaining built into a hollow tree during incubation, and being fed through a small cleft by the male. The larger kinds attract attention by the extraordinary noise they make when flying.

The common European Hoopoe (*Upupa epops*) visits India in winter; the Indian Hoopoe (*U. indica*), which is only just distinguishable from the European species, is a resident and found almost throughout the Empire.

The next group includes the Swifts (*Cypseli*), Nightjars (*Caprimulgi*), and Frogmouths (*Podargi*). The relationship of these forms is an open question. Macrochires.

The Swifts comprise several species of *Cypselus*, among which is the Common Indian Swift (*C. affinis*), resident in the larger towns and breeding upon old buildings. It is replaced east of the Bay of Bengal by the Malay House Swift (*C. subfurcatus*). The European Swift (*C. apus*) and the Alpine Swift (*C. melba*) are winter visitors to India. The little Palm Swifts (*Tachornis*), common about fan-palms, in which they breed, are also represented by distinct species east and west of the Bay of Bengal. To the genus *Chaetura*, comprising the Spinetail Swifts, belong two large species, one Himālayan only, the other Indian and Burmese; they are probably the swiftest of all birds and the most powerful flyers. There are also two smaller species; one (*C. sylvatica*) occurring in some of the larger Indian forests, and the other (*C. leucopygialis*) in Tenasserim and the Malay Peninsula. The genus *Collocalia* consists of the small species sometimes called 'swiftlets,' chiefly inhabiting the sea-coast, and famous as the producers of the edible nests prized by the Chinese. One species, however, is common in the Himālayas. Last come the Crested Swifts (*Macropteryx*), with the sexes differing in colour. One species inhabits well-wooded tracts and forests almost throughout India, Ceylon, and Burma; two others are found in Southern Tenasserim.

The Nightjars or Goatsuckers (*Caprimulgus*) are represented by seven species, all widely distributed. They are nocturnal,

and have peculiar reiterated notes, chiefly uttered in the earlier and later parts of the night, and resembling strokes by a hammer on a plank, or a stone striking ice. The Large-eared Nightjar (*Lyncornis cervinceps*) is found in Burma, the Eastern Himālayas, and Travancore.

Three species of *Batrachostomus* or Frogmouth, the Asiatic representative of the Australian *Podargus*, occur within Indian limits: one in Ceylon and Travancore; a second in the Eastern Himālayas, Assam, and Burma; and the third in Tenasserim. They are shy nocturnal birds, and appear to be rare, but they resemble nightjars in appearance and habit.

Trogones. Trogons, distinguished by the structure of their feet, the first and second toes being directed backwards (not the first and fourth as in Woodpeckers, Barbets, Cuckoos, and Parrots), and by their peculiarly soft and often beautifully coloured plumage, are found in the tropical forests of America, Africa, and the Indo-Malay region. Three species of *Pyrotrogon* or *Harpactes*, the Asiatic representative of the Order, occur in Burma, one ranging to the Eastern Himālayas; and a fourth is found in the forests between the Ganges and the Godāvari, those near the western coasts of India, and in Ceylon.

Coccyges. Indian Cuckoos belong to one family (Cuculidae), and comprise fifteen genera and thirty species, divided into two sub-families not very easily distinguished. All members of the first family (*Cuculinae*) are parasitic, laying their eggs in the nests of other birds, while the majority of the second sub-family (*Phoenicophainae*) build their own nests. To the first family belong four species of true Cuckoo, one of which, the Common Cuckoo of Europe (*Cuculus canorus*), is widely distributed throughout India, and breeds in the Himālayas, and apparently also in Chotā Nāgpur and some other tracts, where its well-known call is frequently heard in April and May. There are also four Indian or Burmese species of Hawk-cuckoo (*Hierococcyx*), which resemble birds of prey even more than the common Cuckoo does. One of these (*H. varius*), found throughout India and Ceylon but not in Burma, has received the name of 'brain-fever bird' from its monotonous repetition of its call-note in the hot season. The Crested Cuckoos (*Coccystes*) and several smaller genera also belong to the sub-family; one of these (*Surniculus*) is remarkable as being an almost exact imitation in form and plumage of the common 'king-crow' or Drongo, and thus affording one of the best examples of what is known as 'mimicry' in the animal kingdom. Another small genus

(*Chrysococcyx*) has glossy metallic plumage, bright-green in the male in one species, violet in another.

Amongst the *Phoenicophainae* two well-known birds are found throughout India, Ceylon, and Burma. One of these is the Koel (*Eudynamis honorata*), a frugivorous cuckoo, with the male glossy-black and the female brown and spotted. The loud note of this cuckoo may be heard from March to July in almost every grove in India, especially about dawn. Unlike most of the *Phoenicophainae*, the female Koel is parasitic and lays its eggs in the nests of crows. The other familiar member of this sub-family is the Coucal (*Centropus sinensis*), often called 'crow-pheasant' in India. The genus *Centropus*, of which there are several species, is distinguished by having a long hind claw. The remaining members of the sub-family are long-tailed ground cuckoos of feeble flight, living in scrub, and belonging to several genera.

The majority of the Indian Parrots, including all the common forms, are Paroquets belonging to the genus *Palaeornis*, distinguished by its long tail and prevailing green colour. Of this no less than fifteen species occur within Indian limits, but this number includes one species peculiar to the Andamans and two to the Nicobar Islands. The best-known kinds are the Large Paroquet, of which four different races inhabit Ceylon, India, Burma, and the Andaman Islands respectively; the Blossom-headed Paroquets, of which one race (*P. cyanocephalus*) is found west and the other (*P. rosa*) east of the Bay of Bengal; and, commonest of all, the Rose-ring Paroquet (*P. torquatus*). The only Indian parrots not included in *Palaeornis* are two members of the small, short-tailed *Loriculus*, birds not larger than a starling, one inhabiting Ceylon, the other the Malabar forests, the Eastern Himālayas, and Burma; and the little Malayan Parrot (*Psittinus incertus*), which is found in Southern Tenasserim. Psittaci.

Thirty-seven species of owls have been recorded within Indian limits, belonging to eight genera. Foremost among these is the Barn Owl (*Strix flammea*), of almost world-wide distribution. Other Indian owls are: (1) two species of *Photodilus*, small Screech Owls, one inhabiting the Himālayas and Burma, the other Ceylon; (2) the Long-eared Owl (*Asio otus*), an occasional visitor to Northern India, and the Short-eared Owl (*A. accipitrinus*), found throughout the area; (3) several Wood Owls belonging to the genus *Syrnium*, very handsome birds, of moderate size, without aigrettes but with feathered tarsi; (4) three kinds of Fish Owl (*Ketupa*), larger Striges.

birds with naked tarsi, usually found near water and living chiefly on fish and crustacea; (5) Eagle Owls, belonging to the genera *Bubo* and *Huhua*, all of large size, with aigrettes and feathered tarsi; (6) several small owls belonging to the genera *Scops*, *Athene*, and *Glaucidium*; and (7) the Brown Hawk Owls (*Ninox*), one of which is said to be the 'devil-bird' of Ceylon, so named from the extraordinary sounds it makes. Of these the commonest and best-known forms are the Brown Fish Owl (*Ketupa zeylonensis*); the Rock Horned Owl (*Bubo bengalensis*), so often seen sitting on rocks or trees in hilly country throughout the Peninsula of India; the variable Scops Owl (*Scops giu*), one form or another of which may be met with almost everywhere in India and Burma; and the Spotted Owlet (*Athene brama*), which is even more widely spread, and, being less purely nocturnal, is much more frequently seen.

Accipitres. Indian birds of prey belong to three families, one containing the Osprey alone, the second the Vultures, the third Eagles, Kites, Harriers, Buzzards, Hawks, and Falcons. The number and variety of diurnal birds of prey in India are very great, no less than eighty-two species having been recognized, representing thirty-five genera.

The Osprey is a winter visitor throughout India and Burma, and may be seen about large rivers and the sea-coast where fish, on which it lives, are numerous.

Vultures abound throughout India and Northern Burma; they are less common in Tenasserim, and wanting in Ceylon. The Cinereous Vulture (*Vultur monachus*) and the Griffon (*Gyps fulvus*) are met with only in Northern India; but the Black Vulture (*Otogyps calvus*), the Indian Long-billed Vulture (*Gyps indicus*), and the White-backed Vulture (*Pseudogyps bengalensis*) are everywhere seen—the first, however, being by no means abundant, while the last is extremely common. Two other species of *Gyps* also occur in the Himālayas. The White Scavenger Vulture (*Neophron ginginianus*) is ubiquitous in India, and haunts the neighbourhood of human habitations; but it is very rare in Ceylon, and unknown in Burma or even in Lower Bengal.

First among the Falconidae comes the Bearded Vulture or Lämmergeyer (*Gypaëtus barbatus*), supposed in the Alps to live upon lambs and occasionally upon children, but found in the Himālayas, where it is common, to subsist upon carrion and to have a particular preference for bones. Besides the Himālayas, this great bird haunts the higher ranges in the

Punjab and Sind. Of the true eagles, the Golden Eagle (*Aquila chrysaëtus*) is found in the Himālayas, and the Imperial Eagle (*A. heliaca*) is far from rare throughout Northern India, chiefly, however, as a winter visitor. The Steppe Eagle (*A. bifasciata*) is another North Indian migrant. The small Tawny Eagle (*A. vindhiana*) is common throughout the greater part of India and in Upper Burma, while the Spotted Eagles (*A. maculata* and *A. hastata*), the latter peculiar to the Indian Peninsula, inhabit the neighbourhood of marshes. Bonelli's Eagle (*Hieraëtus fasciatus*) and the Booted Eagle (*H. pennatus*) are also Indian, but the latter only is Burmese. The various Hawk Eagles (*Lophotriorchis*, *Ictinaëtus*, and *Spizaëtus*) are woodland birds, one or the other of which is found in all Indian forests; while the European Short-toed Eagle (*Circaëtus gallicus*) is found throughout India but not farther east, and the Crested Serpent Eagle (*Spilornis cheela*) is to be met with almost throughout the Empire, and is easily recognized when soaring by its strongly banded wings and tail. It varies greatly in size and somewhat in colour. Two other species of the same genus occur in the Nicobars and Andamans. Next to the true eagles come the small Buzzard Eagles (*Butastur*), with three species; five kinds of Fishing Eagles or Sea Eagles (*Haliaëtus* and *Polioaëtus*), all of large size; and the Brāhmani Kite (*Haliastur indus*), associated with the Hindu deity, Vishnu. This handsome bird, with a maroon back and the head and lower parts white, lives chiefly on fish, and is found commonly in the neighbourhood of water.

The Common Indian Kite (*Milvus govinda*) swarms about towns and villages throughout the Empire, and its peculiar squealing call is almost as well known as the call of the Indian crow. A larger kite also occurs, but is rare. Six or seven different Harriers are winter visitors to the country; among these the commonest is the Marsh Harrier (*Circus aeruginosus*), of which the handsome adult, so rare in Europe, is frequently seen in India. Two other species, the Pale Harrier (*C. macrurus*) and Montagu's Harrier (*C. cineraceus*), are commonly noticed hawking over open, grassy plains; and to the eastward the pied Harrier (*C. melanoleucus*) is found, especially in flat marshy tracts. Buzzards are represented by the Indian race of the Common Buzzard (*Buteo desertorum*), widely distributed but rare; by the Long-legged Buzzard (*B. ferox*) in the Himālayas and North-western India, where it is common in winter; and by two kinds, both rare, one of them a Rough-legged Buzzard,

in the Himālayas only. The Goshawk (*Astur palumbarius*) is also Himālayan and is largely tamed for hawking, while the Shikra (*A. badius*), a much smaller form, is common and resident all over India and Burma. It too is tamed and trained to be flown at quails, partridges, and especially crows. The Crested Goshawk (*Lophospizias trivirgatus*) is a rare forest bird. The common Sparrow-hawk (*Accipiter nisus*) is a winter visitor, and the resident Besra Sparrow-hawk (*A. virgatus*) is rather locally distributed. The Honey Buzzard (*Pernis cristatus*), easily recognized by the closely feathered sides of the head, is not uncommon.

Passing over the rare genera, *Baza* and *Machaeramphus*, the next birds requiring notice are the true falcons. The Peregrine (*Falco peregrinus*) is a winter visitor, while the more deeply coloured Shāhin Falcon (*F. peregrinator*) is resident in the Indian forests; the Barbary Falcon (*F. barbarus*) and the Saker or Cherrug (*F. cherrug*) inhabit North-western India; and the Laggar (*F. jugger*) occurs throughout the Peninsula in open and cultivated country. All these birds are occasionally reclaimed for hawking, but the sport has greatly declined in India during the course of the last century. The Hobby and Merlin are winter visitors, almost confined to Northern India. The Indian Hobby (*Falco severus*) is found in the Himālayas and scattered over India and Burma, while the *turumti* or Red-headed Merlin (*Aesalon chicquera*) is common and resident in many parts of the Indian Peninsula. Kestrels (*Tinnunculus alaudarius*) are generally distributed; the majority are winter visitors, but a few breed in India. The Smaller Kestrel (*T. cenchris*) and the Eastern Red-legged Falcon (*Erythropus amurensis*) are rare migratory forms, only occasionally seen. The only other members of the Falcon tribe requiring notice are the Pigmy Falcons or Falconets (*Microhierax*), small birds scarcely larger than a lark, feeding on insects, inhabiting open tracts in forests, and differing from all other Accipitrine birds by laying their eggs in holes in trees, like owls and parrots. One species (*M. eutolmus*), with much rufous beneath, is found in the Himālayas and Burma; a second (*M. melanoleucus*), pure white beneath, in Assam; and a third (*M. fringillarius*), in Tenasserim.

Columbae. Pigeons and Doves are common birds in all parts of India and Burma, and no less than six different groups, families, or sub-families are represented. The first of these, the Green Pigeons (*Treroninae*), are birds of yellowish-green plumage, often with patches of chestnut or lilac on the upper surface.

All have feet adapted for perching; they live in flocks among the trees, and feed on fruit. The commonest forms are species belonging to the genus *Crocopus*, which are often met with near towns and villages, and which haunt the Banyan and Pipal when those trees are in fruit. The other species are forest birds, and are not found in the cleared and cultivated parts of the country.

The second group is composed of the large Imperial Pigeons, most of which are dark-green or coppery-brown on the back and grey below. They keep to the forest tracts, such as the Himālayas, Burma, Orissa, and the Malabar coastlands, and feed on fruit. One black and white bird, the Pied Imperial Pigeon, inhabits the Malay Archipelago and extends its range to the Andamans and Nicobars. The same area is inhabited by the only member of the third group, the beautiful Nicobar Pigeon (*Caloenas nicobarica*), which has long neck-hackles and a prevailing coloration of metallic green with bronze reflections; it breeds in enormous numbers on Batti Malv, an uninhabited island of the Nicobars. The fourth sub-family is also represented in India by a single species, the Bronze-winged Dove (*Chalcophaps indica*), which haunts damp and thickly wooded tracts and, like the Nicobar Pigeon, feeds on the ground. The True Pigeons (*Columbinae*) comprise the Indian Blue Rock Pigeon, a very near ally of the Blue Rock of Europe, and found, like that bird, breeding on rocks or buildings, and, very commonly in India, in the sides of wells, and also eastern races of the Stock Pigeon or Stock Dove and Wood Pigeon; but while the first-named species is widely spread, the two latter are found only in North-western India. Several kinds, allied to the Wood Pigeon but belonging to distinct genera (*Dendrotreron* and *Alsocomus*), are met with in the forests of the Himālayas, Burma, Southern India, and Ceylon; but they are rare forms, whilst the Doves, of which eight species occur in India, furnish some of the commonest birds in the country. The only remaining group (*Geopeliinae*) is represented by a single Malay species, found within our limits only in Southern Tenasserim. Carpophaginae.

The Sand-grouse are intermediate in structure between Pigeons and the true Game Birds. They are chiefly found in open country, being most abundant in the dry semi-desert tracts of Sind and the Punjab. They are as a rule about the size of a pigeon—a few being larger—and of a yellowish-brown colour; they are swift of flight, they always rest and feed on the ground, and they fly to water at particular hours in the Pterocletes.

morning and evening. Seven species occur in India, but none are known in the countries east of the Bay of Bengal, and only two of the seven are met with elsewhere in India than in the Punjab, Sind, Rājputāna, and the United Provinces, while one species, belonging to a different genus (*Syrrhaptes tibetanus*), is peculiar to Tibet.

Gallinae. The Game Birds proper, Peafowl, Jungle-fowl, Pheasants, Partridges, Quails, &c., include fifty-eight species enumerated in the *Fauna*, a number raised to seventy-one in Mr. Oates's *Game Birds of India*. The difference depends partly upon the limits assigned to the area, and partly on the question whether certain pheasants should be regarded as species or varieties; but some of Mr. Oates's additions are recent discoveries within Indian limits.

Peafowl are met with throughout the greater part of India, Ceylon, and Burma; but the Burmese and Malay species (*Pavo muticus*) is distinct from the Common Peacock of India and Ceylon (*P. cristatus*), having the neck green instead of blue, and a different crest. In some parts of India peafowl are considered sacred by Hindus, and they live in a semi-domesticated state around villages in Gujarāt, Rājputāna, and Sind.

The great Argus Pheasant (*Argusianus argus*), a Malay species, is known within Indian limits only in Southern Tenasserim. The Grey Peacock Pheasant (*Polyplectrum chinquis*) inhabits the forests of the Lower Himālayas east of Sikkim, and the hill ranges of Assam and Burma.

The Indian Jungle-fowls are three in number. The Red Jungle-fowl (*Gallus ferrugineus*), from which all domestic fowls are derived, inhabits a large part of South-eastern Asia, including Burma, Assam, the Lower Himālayas throughout, and the Peninsula as far south as the Godāvari to the eastward, but not west of about 80° E. long. The remainder of the Indian Peninsula is inhabited by the Grey Jungle-fowl (*G. sonnerati*), easily recognized by yellow and white spots of peculiar structure on the neck-hackles of the male; while a third species (*G. lafayettii*) is peculiar to Ceylon. Each has its own peculiar call-note or crow. The Burmese race of Red Jungle-fowl differs from the Indian by having a red instead of a white ear-lappet, and it is said to be more easily tamed.

Jungle-fowls are very nearly allied to Pheasants, of which however, using the name as generally understood, none inhabit India proper or Ceylon, while four Himālayan genera are unknown in any other part of the Empire. These are the

Chīr Pheasant (*Catreus wallichi*), the Koklas or Pucras (*Pucrasia macrolopha*), the Monals (*Lophophorus refulgens* and *L. impeyanus*), and the Blood Pheasant (*Ithagenes cruentus*). The Horned Pheasants or Tragopans, sometimes wrongly called Argus Pheasants, are represented by two species in the Himālayas, one (*Tragopan melanocephalus*) to the westward, and the Crimson Horned Pheasant (*T. satyra*), in Nepāl, Sikkim, and Bhutān, while a third species (*T. blythi*) is found in some of the higher hill ranges south of Assam. All of these genera are Central Asiatic and are represented in parts of China. The true pheasants of the genus *Phasianus*, occurring throughout temperate Asia, are represented by two species (*P. humiae* and *P. elegans*) in Northern Burma and Manipur; while the beautiful Amherst Pheasant (*Callophasis amherstiae*) has been met with on the frontier between Burma and Yunnan, and one species of the Malayan Fire-backed Pheasants (*Lophura rufa*) ranges into Southern Tenasserim. The genus *Gennaeus*, containing the Silver Pheasants of China and the Himālayan Kalij, comprises four species in the Lower Himālayas (one of them also inhabiting the ranges south of Assam), and several Burmese kinds, the precise number being rather uncertain, as they show a tendency to pass into each other. To the eastward these birds approach the Chinese Silver Pheasant in plumage and size; to the westward they resemble more nearly the Himālayan Kalij. They are known as Silver Pheasants in Burma.

The Spur-fowls (*Galloperdix*) are about the size of a partridge. They keep to forests and are found only in India and Ceylon, being unknown east of the Bay of Bengal and west of the Indus river, though one species occurs at the base of the Himālayas in Oudh. Their name is derived from the presence of two or more spurs on each tarsus in the male, and sometimes in the female. Two kinds inhabit the Indian Peninsula, and one is peculiar to Ceylon. A bird known as the Western Bamboo Partridge (*Bambusicola fytchii*), found in the hills of Northern Burma and Assam, and congeneric with species inhabiting Southern China and Formosa, may represent the Spur-fowls of India.

A considerable number of small Indian gallinaceous birds not having any very definite relations to each other may for convenience be classed collectively as Quails. The most important are the Common or Grey Quail (*Coturnix communis*), a winter visitor to India and Burma, and the Black-breasted or Rain Quail (*C. coromandelica*), a resident species. To the eastward a few individuals of the Japanese race of the Grey Quail

(*C. japonica*) are said to have been obtained. Next in importance are five species of Bush Quail: two of *Perdicula*, peculiar to the Indian Peninsula, except that one of them occurs in Northern Ceylon; and three of *Microperdix*, two of which inhabit the Indian Peninsula, while the third has recently been discovered in Manipur. Then there is the Blue-breasted Quail (*Excalfactoria chinensis*), resident in swampy country throughout the Empire; and two species which only just come within our limits—the Mountain Quail (*Ophrysia superciliosa*), of which a very few specimens have been obtained at Mussoorie and Nainī Tāl; and the Green Wood Quail (*Rollulus roulroul*), a Malay bird found in Southern Tenasserim.

Another group may be classed as Partridges. This includes in the first place five species of *Francolinus*, beginning with the Black Partridge or Common Francolin of the Mediterranean countries (*F. vulgaris*), found throughout Northern India, but replaced in the Bombay and Madras Presidencies generally by the Painted Partridge (*F. pictus*), and in Northern Burma by the Chinese Francolin (*F. chinensis*). Two other Indian partridges, by many arranged in a different genus (*Ortygiornis*), are the common Grey Partridge, found throughout India and Northern Ceylon, and also westward as far as the Persian Gulf, but not east of the Bay of Bengal; and the Kyah or Swamp Partridge, which inhabits the high grass jungles of the Ganges and Brahmaputra plains. The remaining partridges are not found in the Indian Peninsula. They are the Chikor (*Caccabis chucar*) and the Sīsī (*Ammoperdix bonhami*), Western Asiatic types, both found in the hills of the Punjab and Sind, and the Chukor also throughout the Western Himālayas; a species of true Partridge (*Perdix hodgsoniae*), allied to the European bird but inhabiting Tibet; and the Hill Partridges (*Arboricola*, *Tropicoperdix*, and *Caloperdix*), three of which, belonging to *Arboricola*, are Himālayan, and five more Assamese or Burmese. All are about the same size as the common partridge, and they are rather handsome birds, inhabiting forest.

In the Higher Himālayas are found the Snow Partridge (*Lerwa nivicola*), a bird much resembling Red Grouse in size and appearance; and two species of Snow Cocks (*Tetraogallus*), fine birds about the size of a Capercaillie.

Lastly, in the Nicobar Islands, a species occurs of the family Megapodiidae, the other members of which family inhabit the Philippines, Celebes, Papuasia, and Australia. Like their allies, the Nicobar Megapodes lay their eggs in mounds of decaying

vegetable matter built by themselves and supplying the heat necessary for incubation.

Hemipodii.

Although differing in several important anatomical characters, the five species of Hemipodes (*Turnix*) found in the Indian Empire much resemble quails in size, appearance, and plumage, but are distinguished by having no hind toe. Females are larger than males, and while the latter sit on the eggs and guard the young brood, the females challenge and fight each other. These birds are generally found singly in grass.

Grallae.

The next Order consists of Rails, Finfeet, Cranes, and Bustards. The Rails (Rallidae) comprise nineteen species belonging to ten genera. Several are Water-rails, belonging to the genera *Rallus*, *Hypotaenidia*, and *Porzana*; there are three kinds of banded Crakes (*Rallina*), and other Crakes, Water-hens, and Moor-hens, referred to *Amaurornis* and *Gallinula*. These are seldom seen, as they hide in grassy swamps; the only birds at all commonly observed are the White-breasted Water-hen (*Amaurornis phoenicurus*) and the common Moor-hen (*Gallinula chloropus*), both of which are widely distributed throughout India and Burma. The Kora or Water Cock (*Gallicrex cinerea*) inhabits warm swampy plains, especially in Bengal and Assam, and is often kept tame by natives. The Purple Moor-hen (*Porphyrio poliocephalus*) is common among high reeds around large marshes, and climbs about the reeds like a gigantic Grass-warbler; and the Common Coot (*Fulica atra*), though very locally distributed, is found on many of the larger pieces of inland water.

The Masked Finfoot (*Heliopais personata*), the toes of which are lobed like a Coot's, is the only Asiatic representative of the family Heliornithidae, the few other existing members of which are African or American. It is found on the coast, or on rivers, from Assam through Burma to Malacca and Sumatra.

Six kinds of Cranes (Gruidae) are met with in India or Burma. Of these the Demoiselle (*Anthropoides virgo*), the Common Crane (*Grus communis*), and the Great White Crane (*G. leucogeranus*) are winter visitors to Northern India, the Demoiselle and Common Crane being found as far south as the Deccan, often in large numbers. The Sāras Crane (*G. antigone*) and its Burmese representative (*G. sharpii*) are resident species, large and beautiful birds, generally protected and seldom or never molested by the inhabitants of the country. They are consequently very tame. Another Crane (*G. monachus*), a species of North-eastern Asia, has recently been obtained in Assam.

The Bustards are six in number. None of them occur in Burma or in Ceylon. The Great Bustard and Little Bustard of Europe have been occasionally obtained in the extreme North-west of the Punjab only. The Great Indian Bustard (*Eupodotis edwardsi*), males of which often weigh 25 to 30 lb., is resident; it haunts open plains in North-western India and the Deccan as far south as Mysore. The Houbara (*Houbara macqueeni*), a much smaller bird, is a winter visitor to the Punjab, Sind, Rājputāna, and Northern Gujarāt. The two Floricans (*Sypheotis*) are peculiar to India and breed in the country; the smaller of them (*S. aurita*) being found throughout the Peninsula, while the larger species (*S. bengalensis*) is met with only in the plain of the Ganges and Brahmaputra. In both the male becomes black in the breeding season.

Limicolae. The next Order contains, besides the Plovers and Snipes, several families of wading-birds of small or moderate size.

The first of these families contains the Stone Curlews or Stone Plovers (*Oedicnemidae*), represented by the Common Stone Curlew, often called the Bastard Florican in India (*Oedicnemus scolopax*), an inhabitant of stony plains, and also two species of *Esacus*, the Great Stone Plover (*E. recurvirostris*), found on the banks of rivers, and the Australian Stone Plover (*E. magnirostris*), which lives on the shores of the Andaman Islands. The next family (Dromadidae) contains a single species, the Crab Plover (*Dromas ardeola*), a white bird the size of a pigeon, found locally on the shores of the Indian Ocean. The third family (*Glareolidae*) comprises the Coursers and Pratincoles. The Coursers or Courier Plovers include two species of *Cursorius* (*C. coromandelicus*), peculiar to India, and a European bird (*C. gallicus*), found in the Punjab, Sind, and Rājputāna. These birds inhabit open plains; but the third Courser (*Rhinoptilus bitorquatus*), a member of a genus that is with this exception purely African, is found in thin forests from the Godāvari valley to the neighbourhood of Madras. Of Pratincoles or Swallow Plovers (*Glareola*), three species are Indian, two being widely distributed and breeding, whilst the third is the European Collared Pratincole, which has been found in Sind. A fourth family (Parridae) consists of the Jaçanās, marsh birds with enormously long toes and claws, by means of which they can run over floating leaves of water-lilies and other plants. Two species are Indian, the Bronze-winged Jaçanā (*Metopidius indicus*) and the Pheasant-tailed Jaçanā (*Hydrophasianus*

chirurgus), both found throughout India and Burma in suitable localities.

The Plover family (Charadriidae) includes, besides Plovers and Snipes, a considerable number of waders, many of which are migratory, and it may be divided into four sub-families. The first of these (*Charadriinae*) contains, besides the Plovers proper, the Turnstone, a rare winter visitor to the sea-coast. Then come several birds more or less allied to the Lapwing (*Vanellus vulgaris*), itself a winter visitor to North-western India. These are the Red-wattled (*Sarcogrammus*) and Yellow-wattled Lapwing (*Sarciophorus*), common Indian types, known by their peculiar cries, that of the former being anglicized as 'Did-you-do-it' ('Pity-to-do-it' is nearer the bird's cry). A species of *Sarcogrammus* occurs in Burma, but no *Sarciophorus* ranges east of the Bay of Bengal. Another allied form is the Indian Spur-winged Plover (*Hoplopterus ventralis*), found on the banks of rivers, usually singly, in Central and North-eastern India and Burma. Here also belong some migratory birds included in the genera *Microsarcops* and *Chettusia*, which visit parts of Northern India in winter. The typical migratory plovers are the Eastern Golden Plover (*Charadrius fulvus*), found in open country throughout the Empire in winter; the European Golden Plover (*C. pluvialis*), occasionally obtained in North-western India; the Grey Plover (*Squatarola helvetica*), not common but widely distributed; and several species of *Aegialitis* or Sand and Ring Plovers, one of which, the Little Ringed Plover (*Ae. dubia*), common throughout the Empire, breeds in large numbers in India, although even in this case the majority of the birds seen in winter are migratory. The Kentish Plover (*Ae. alexandrina*) also breeds at times in the Indian Peninsula.

The next sub-family (*Haematopodinae*) contains the Sea-Pie or Oyster-catcher (*Haematopus ostralegus*), a winter visitor to the Indian coast; the Black-winged Stilt (*Himantopus candidus*), a common, and the Avocet (*Recurvirostris avocetta*), a rare winter visitor, the former alone extending its range to Burma; and the Ibis-bill (*Ibidorhynchus struthersi*), formerly known as the Red-billed Curlew, a Central Asiatic bird, found resident on the Higher Himālayas and the Nāgā Hills in Assam.

The *Totaninae* contain the Curlews, Godwits, Sandpipers, and Stints. Both the Curlew (*Numenius arquata*) and the Whimbrel (*N. phaeopus*) are winter visitors, and so is the Black-tailed Godwit (*Limosa belgica*), while the Bar-tailed Godwit (*L. lapponica*) has hitherto been obtained within Indian

limits only in Sind. Sandpipers and Stints are found everywhere, the commonest forms in India being the Wood Sandpiper (*Totanus glareola*) and the Green Sandpiper (*T. ochropus*), both known as 'snippets' by Indian sportsmen. Redshanks, Spotted Redshanks, Greenshanks, Ruffs and Reeves, Sanderlings, Little Stints, and other kinds of *Tringa*, Dunlins, and Red-necked Phalaropes are among the migratory waders that visit India in winter, while some other forms, as the Grey Phalarope, have been obtained occasionally. The Red-necked Phalarope is common on the Baluchistān coast, where it spends the day in flocks on the sea, often several miles from land.

The Woodcocks and Snipes, with long, soft sensitive bills, form the last sub-family (*Scolopacinae*). The Woodcock breeds on the Himālayas, and in winter visits the Nīlgiris and other hill ranges of Southern India in considerable numbers. The Snipes found generally in India belong to two species: the Common Snipe, or Fantail (*Gallinago coelestis*), identical with the European bird; and the Pintail Snipe (*G. stenura*), an eastern species, distinguished by having twenty-six tail-feathers instead of fourteen or sixteen, the outer eight on each side being narrow and stiff, and by some slight differences of plumage, especially by the wing-lining and axillaries being richly barred with blackish-brown. The Common Snipe is the more abundant to the westward in India, the Pintail is the prevalent form in Burma. The Jack Snipe (*G. gallinula*) is rare, except occasionally in Northern India. Two large snipes, the Wood Snipe (*G. nemoricola*) and the Himālayan Solitary Snipe (*G. solitaria*), inhabit the Himālayan and Assam hills, and the former is also found in the hills of Southern India. The Painted Snipe (*Rostratula capensis*), a non-migratory bird of weak flight, with the sexes differing in plumage, is found throughout India, Burma, and Southern Asia, and also in Africa and Madagascar.

Gaviae. Gulls and Terns form an Order by themselves, nearly allied to the Plovers, as might be inferred from the similarity between the eggs.

Seven kinds of Gull are found on the coasts of Sind and Baluchistān; of these only four are known from the Bay of Bengal, and only two in Ceylon, there being a considerable diminution in the numbers to the eastward and southward. The commonest kinds in India are the Laughing Gull (*Larus ridibundus*), the Brown-headed Gull (*L. brunneicephalus*), and the Yellow-legged Herring-gull (*L. cachinnans*), with, to the westward, the Sooty-Gull (*L. hemprichi*), the Slender-billed

Gull (*L. gelastes*), and the Dark-backed Herring Gull (*L. affinis*). The first three are often seen about rivers and large marshes inland. None breed in the Indian Peninsula.

Terns are more numerous in India than gulls, there being twenty-one species known, including two kinds of Noddy (*Anous*), only found on the open sea, and three other oceanic terns. The common terns found inland about rivers and marshes are the Whiskered Tern (*Hydrochelidon hybrida*), the Caspian Tern (*Hydroprogne caspia*), the Gull-billed Tern (*Sterna anglica*), the Indian River Tern (*S. seena*), and the Black-billed Tern (*S. melanogaster*), the last being one of the commonest of Indian water-birds. The Indian Skimmer, or Scissors-bill (*Rhynchops albicollis*), with both mandibles of the bill compressed and the upper the shorter, is very tern-like in appearance, but differs in many respects. It keeps to rivers and large pieces of fresh water.

Richardson's Skua (*Stercorarius crepidatus*) occurs in winter on the Makrān and Sind coasts, and individuals of two other species of Skua have been recorded within Indian limits.

Steganopodes.

Pelicans, Frigate-birds, Cormorants, Gannets or Boobies, and Tropic-birds, all distinguished by having the four toes united by a web, form the next Order. Only the Pelicans and Cormorants are found inland; members of the other three families are oceanic; two kinds of Frigate-birds, three Boobies, and three Tropic-birds have been observed in the Indian seas.

Four kinds of Pelicans occur in India; but of these the Dalmatian Pelican (*Pelicanus crispus*) is only found in winter in the north-western part of the country, and *P. onocrotalus* is rare as an Indian bird. The other two species, the Eastern White Pelican (*P. roseus*) and the Spotted-billed Pelican (*P. philippensis*), are more generally distributed, the latter being the commonest, and breeding in the country.

Three Cormorants are among the resident Indian water-birds: the Large Cormorant (*Phalacrocorax carbo*), the Indian Shag (*P. fuscicollis*), and the Little Cormorant (*P. javanicus*), the latter being by far the commonest. The Indian Darter or Snake-bird (*Plotus melanogaster*) is also generally distributed. Of the four Indian members of the Cormorant family, the Large Cormorant alone is met with on the sea.

Tubinares.

The Petrels are oceanic birds. Five species have been recorded in the seas around India, and others indicated. Small Stormy Petrels are not rare, and probably two or three species are represented, but very few specimens have been obtained. A Shearwater (*Puffinus persicus*) is met with off

Bombay and Sind, and another species (*P. chlororhynchus*) has been occasionally recorded from Ceylon and Makrān.

Herodiones. The Ibises, Spoonbills, Storks, and Herons form a far more important part of Indian bird life. The Ibises are the White Ibis (*Ibis melanocephala*), a near relative of the Egyptian Sacred Ibis; two kinds of Black Ibis (*Inocotis papillosus* of Northern India, and *I. davisoni* of Southern Burma); and the Glossy Ibis. All except the last are resident, and even the Glossy Ibis breeds in Sind and in Ceylon. Spoonbills (*Platalea leucorodia*) are somewhat local, but they occur and breed in several parts of India, though not in Burma.

Among Storks, the common White Stork (*Ciconia alba*) and the Black Stork (*C. nigra*) are winter visitors to Northern India, while the White-necked Stork (*Dissura episcopus*), a common Indian bird, the great Black-necked Stork (*Xenorhynchus asiaticus*), two kinds of Adjutant (*Leptoptilus dubius* and *L. javanicus*), the Painted Stork (*Pseudotantalus leucocephalus*), and the curious Open-bill (*Anastomus oscitans*) are resident. The Larger Adjutant (*L. dubius*) was formerly common in Calcutta from March to October, being attracted by the heaps of refuse; but improved sanitary regulations have banished both offal and Adjutants from the city. All the storks named are widely distributed, but *Anastomus* is particularly common in the great plain of Northern India.

The Heron family (*Ardeidae*) is represented by eleven genera and twenty-one species. The principal of these are the Common Heron (*Ardea cinerea*), the Eastern Purple Heron (*A. manillensis*), and the three White Egrets (*Herodia alba*, large; *H. intermedia*, smaller; and *H. garzetta*, smaller still), with the Cattle Egret (*Bubulcus coromandus*), which is white in winter, but becomes buff-coloured in the summer. All of these are common and widely distributed. The Reef Herons (*Lepterodius*) keep to the coasts, and present the remarkable peculiarity of some individuals being pure white, others slaty grey. The small Pond Herons, or 'paddy-birds' as they are commonly called in India, belong to the genus *Ardeola*. One of them (*A. grayi*) occurs throughout the Empire and is very common; it is dull greyish-brown when sitting, but makes a startling display of its white body and wings when it flies away. A second species (*A. bacchus*) inhabits Burma. The Little Green Heron (*Butorides javanica*) and the Night Heron (*Nycticorax griseus*) are crepuscular in their habits, as are the Malay Bittern (*Gorsachius*), several species of Little Bitterns (*Ardetta*), the Black Bittern (*Dupetor flavicollis*), and the

European Bittern (*Botaurus stellaris*), the latter alone being migratory. None of the Bitterns are common; all hide in long grass and reeds during the day.

Phoenicopteri.

Two Flamingoes are found in India and Ceylon, none being known to the east of the Bay of Bengal. The Common Flamingo (*Phoenicopterus roseus*) is locally common, especially in the north-west of India. The Lesser Flamingo (*P. minor*) is a rare bird.

Anseres.

Two kinds of swan, the Mute Swan (*Cygnus olor*) and the Whooper (*C. musicus*), have been obtained as rare stragglers in North-western India. Of geese, five species visit the country in winter, but only two are anywhere common. These are the Grey Lag (*Anser ferus*), which is a visitor to Northern India and Northern Burma, and especially to North-western India; and the Barred-headed Goose (*A. indicus*), which is common in winter in Northern India and Burma, and rarer, though occasionally met with, as far south as Mysore.

Ducks are numerous, most of the common European kinds visiting India, and there are several resident species as well. Altogether twenty-one genera are represented, or, including Smews and Mergansers, twenty-three. The majority are winter visitors; and of these the Sheldrake, Mallard, Widgeon, and Marbled Duck, as well as some occasional visitors, such as Falcated Teal, Baikal Teal, Eastern (or Baer's) White-eyed Duck, Scaup, and Golden-eye, appear only in the northern part of the country; others, like the Gadwall, Shoveller, Pochard, Red-crested Pochard, White-eyed and Tufted Ducks, range about as far south as Mysore in India and Ava in Burma, but are rare or wanting farther to the southward. A few, however, of which the principal are the Ruddy Sheldrake or Brāhmani Duck, commonly seen in pairs on the banks of rivers, the Pintail, Common Teal, and Blue-winged Teal or Garganey, are found almost throughout the Empire in winter. The Mallard and White-eyed Duck breed in large numbers in Kashmīr.

The resident Ducks, which breed in tropical India, are the following: the Comb Duck or Nukta (*Sarcidiornis*), widely distributed; the rare White-winged Wood Duck of Assam, Burma, and the Malay countries; the Pink-headed Duck (*Rhodonessa*), almost peculiar to Upper Bengal; the two Whistling Teals (*Dendrocygna*), found generally throughout the Empire, the smaller kind (*D. javanica*) being very common; the little Cotton Teal (*Nettopus coromandelianus*), with similar distribution; the Spotted-billed Duck (*Anas poecilorhyncha*), common in India and Northern Burma,

but replaced in parts of the Shan States by the allied Chinese species (*A. zonorhyncha*); and the Andaman Teal, almost peculiar to the Andaman Islands, though it has been obtained in Pegu.

Smews visit Northern India in winter, and the Goosander (*Merganser castor*) is common along the base of the Himālayas at the same season. The Goosander has also been found in parts of Bengal and in Northern Burma, and it breeds in the interior of the Himālayas. The Red-breasted Merganser is a rare visitor in winter to the coasts of Sind and Bombay.

Pygopodes. The Indian Little Grebe (*Podicepes capensis, v. albipennis*) is a permanent resident generally distributed in India and Burma. The Great Crested Grebe (*P. cristatus*) visits Northern India and Burma in winter; and the Eared Grebe (*P. nigricollis*) is of much rarer occurrence.

Reptiles

The Reptiles of India are far more numerous than the Mammals, and more destructive to human life; snake-bites alone cause more deaths than all the wild beasts together. As already stated, 146 genera and 534 species of Reptiles were described in the *Fauna* in 1890; but a fresh enumeration made ten years later, in 1900, shows an increase in the numbers to 153 genera, containing 558 species. These belong to three Orders: (1) *Emydosauria*, or Crocodiles; (2) *Chelonia*, or Tortoises and Turtles; and (3) *Squamata*, or Lizards and Snakes.

Crocodiles. Three kinds of Crocodile inhabit India, two with broad snouts belonging to the genus *Crocodilus*, and one with an elongate snout belonging to the genus *Gavialis* or Ghariyāl. The former are often called 'alligators' in India; but no representative of the American crocodiles, to which the name 'alligator' properly applies, is Indian, although one is Chinese.

The common fresh-water Crocodile of India, Ceylon, and Burma, found in almost every river and marsh and often in ponds, is *C. palustris*, the *magar* of Northern India, a species that seldom, if ever, exceeds 12 feet in length. The large crocodiles found in Indian and Burmese estuaries and in some of the larger rivers, and occasionally seen in the sea, belong to another species (*C. porosus*), which attains much greater dimensions and has even been known to measure more than thirty feet long. This large crocodile is found in suitable localities all round the Bay of Bengal, and also west of Cape

Comorin in Travancore and Cannanore, but it has not been positively identified farther to the north-west. It is still uncertain which species inhabits the delta of the Indus, but *C. palustris* is found at Magar Pīr, west of Karāchi, and in Baluchistān. *C. porosus* is distinguished from *C. palustris* by having a snout more than 1½ times as long as it is broad, and generally by wanting the two pairs of small anterior nuchal shields just behind the occiput and considerably in front of the four large shields, with two or four smaller scutes at the side, at the back of the neck, which are found in both species. In *C. palustris* the snout is less than 1½ times as long as it is broad.

The Ghariyāl has had its name converted into 'Gavial,' probably through a blunder or a misprint. It is purely a fish-eating river crocodile, never found in ponds or marshes, nor (so far as is known) in tidal estuaries. It inhabits the rivers Indus, Ganges, and Brahmaputra and their tributaries. It is also found in the Mahānadī river in Orissa, and the Kaladan in Arakan; and as the Ghariyāl never crosses the land as *C. palustris* does, nor enters the sea as *C. porosus* is in the habit of doing, its presence in the Mahānadī and Kaladan may indicate that these rivers were at one time tributaries of the Ganges. The Ghariyāl is a species of considerable antiquity, and its remains are found abundantly in the Pliocene beds of the Siwālik hills.

The few species of land tortoises properly so called that are found in India and Burma are of no particular interest. The commonest, *Testudo elegans* in India and *T. playtynota* in Burma, have prettily marked shells with radiating yellow streaks on a black ground. The ordinary fresh-water tortoises inhabiting rivers and marshes are numerous and belong to various genera; more are found in Burma than in India, but eight species are recorded from the Gangetic area. Among these are the comparatively large *Batagur baska* and one or two allied species, of which the carapace is often 1½ to 2 feet long. These are herbivorous and edible. Chelonia.

The river turtles of the genus *Trionyx* and its allies are generally depressed in form and have the carapace covered by a soft skin. Some grow to a considerable size, exceeding the measurements usually given in books; thus *Chitra indica* is said by Theobald to have a carapace three feet long. These turtles are carnivorous and aggressive. The genus *Emyda*, belonging to the same family, is smaller and more globose. All are widely distributed.

In the seas around India are found the Green Turtle

(*Chelone mydas*), the Hawk's-bill Turtle (*C. imbricata*), both with four pairs of lateral or costal shields above, the Loggerhead (*Thalassochelys caretta*) with five pairs, and the great Leathery Turtle (*Dermochelys coriacea*). The Green Turtle alone is herbivorous and edible. The Hawk's-bill Turtle yields the tortoise-shell of commerce.

Squamata. Lizards and snakes are remarkably numerous, the former being represented in India, Ceylon, and Burma by 55 genera and 225 species, besides a Chameleon; and the latter by no less than 78 genera and 286 species. The distribution within the Indian area of these two groups, of which only a few types are fluviatile or marine, is different from that of the crocodiles, which are entirely aquatic, and the tortoises, which are mainly aquatic. Among the land Reptiles there is a greater distinction between the genera inhabiting different parts of the area than is the case with the Mammals and Birds.

Eight different families of Lizards are represented in the Indian Empire, but three of them furnish the bulk of the genera and species. These three are the Geckoes (Geckonidae), Agamoids (Agamidae), and Scinques (Scincidae), comprising between them thirty-five genera and 200 species. Geckoes are the most familiar of all, because several species, belonging to the genus *Hemidactylus*, are found in houses, and are well-known by the facility with which they cling to walls and ceilings by means of the peculiar plates with which the lower surface of their digits is furnished. Besides the small House Geckoes found commonly in India, a larger species, often a foot long (*Gecko verticillatus*), enters human habitations in Eastern Bengal and Burma, where it goes by the name of *touk-tai*, a name derived from its loud call. Other Geckoes also have calls, though generally less loud. The great majority of the Geckoes are nocturnal; they are found on rocks, stems of trees, or the ground.

Several of the agamoid lizards are forest-dwellers, among these being the so-called Flying Lizards belonging to the genus *Draco*, represented by several species in Assam and Burma, and by one species isolated in Malabar. Most of the agamoids are, however, ground lizards. Two kinds, *Uromastix* of North-western India and *Liolepis* inhabiting Burma and Travancore, live in holes in the ground made by themselves. Both are herbivorous, whilst other agamoids are insectivorous. By far the commonest agamoid lizard is *Calotes versicolor*, found all over the Empire, and known as the 'bloodsucker' in Southern India. Males of this lizard assume brilliant colours

in the breeding season, red and black predominating. Scinques are ground lizards, usually of small size, with short limbs (occasionally rudimentary or wanting), and a more or less anguiform mode of progression. In their movements, and in their being clad in small and generally polished scales, they approach the snakes. The other families that require notice are the Lacertidae or true lizards, of which fifteen species are known in various parts of India, and the Varanidae or Monitors, called *goh-sāmp* in Hindī. These last are much larger than other lizards; one species (*Varanus salvator*) grows to a length of over six feet, and is found about rivers, estuaries, and marshes, often in the water. Other species of smaller dimensions inhabit drier localities; one (*V. griseus*) is found in the desert regions of North-western India. A single species of Chameleon inhabits the wooded regions of the Indian Peninsula and Ceylon; but no representative of this typically African group is found to the east of the Bay of Bengal, nor even, so far as is known, in the Himālayas.

Snakes constitute more than half of the Indian Reptiles. Snakes. In many, perhaps in most, parts of India it would nevertheless be difficult to find more than about a dozen species, and these would need some searching for; the large total is made up by a great number of local forms inhabiting particular localities. Thus, one whole family of small snakes, the Rough Tails (Uropeltidae), comprising seven genera and forty-two species, is peculiar to Southern India and Ceylon, and almost confined to the hill tracts. This is the only instance known of a family of snakes having so small a range. In fact, India is the only country in the world inhabited by all the known families of living snakes.

The Typhlopidae, thirteen species, are still smaller than the Uropeltidae, some of them almost resembling worms in appearance. One species (*Typhlops braminus*), 7 inches long and $\frac{1}{5}$ to $\frac{1}{8}$ inch in diameter, is common, and is occasionally met with in large numbers in decayed wood. Passing over one or two other small groups, the next that deserves notice contains the largest living snakes. This is the Boidae, to which Pythons and Boas belong. One species of Python (*P. molurus*) is found in parts of India, another (*P. reticulatus*) inhabits Burma and the Malay countries. The latter is the larger, and is said to grow to 30 feet in length; *P. molurus* rarely exceeds 12 feet, though individuals up to 20 feet long have been recorded. Allied to the Boas are the genera *Gongylophis* and *Eryx*, none of which much exceed 3 feet in

length. They have very blunt tails, and one species (*Eryx johnii*) is commonly carried about by snake-charmers and exhibited as a two-headed snake, the tail being occasionally manipulated and furnished with glass eyes to assist in the delusion.

The great majority of Indian snakes, however—57 genera out of 78 and 200 species out of 286—belong to the family Colubridae, divided into three sections, the first comprising forms with solid teeth, the second including those with one or more of the posterior maxillary teeth grooved, and the third with the anterior maxillary teeth grooved or perforated. Snakes of the first section are harmless; those of the second division are probably all slightly poisonous, but they are in no case dangerous to human life; the third section includes some of the most poisonous snakes known. It should be added here that it is extremely difficult to distinguish a venomous snake from a harmless one except by the examination of its teeth. All dangerous venomous snakes, whether belonging to the Colubrine family or not, have a perforated or grooved fang in front of all the other teeth on each side of the upper jaw, and this fang is almost always considerably elongate.

To the first section of Colubrine snakes and the sub-family *Colubrinae* belong a very large number of Indian species, of which the best known and commonest are the following. *Lycodon aulicus*, sometimes called the 'carpet snake,' rarely exceeds 2 feet in length; it is dark brown or blackish with, in general, whitish reticulation. This snake is often mistaken for the venomous *karait*, which is similarly marked, but which grows to a considerably larger size. The *dhāman* or Rat Snake (*Zamenis mucosus*), the largest of the common snakes, often measures between 6 and 7 feet in length. This snake lives on small mammals, lizards and frogs, and is found throughout the Empire, while an allied species (*Z. korros*) inhabits Burma and the Eastern Indo-Malay region. Another and smaller *Zamenis* (*Z. ventrimaculatus*) is perhaps the commonest snake in the dry regions of North-western India. Some of the species of *Tropidonotus* are also common, especially the pretty little *T. stolatus*, which is particularly abundant in Bengal and Burma, and the larger *T. piscator*, generally found in or near water.

The second section of the Colubrine snakes, having one or more of the posterior maxillary teeth grooved, comprises three sub-families all represented in India. One of these, however,

distinguished by the possession of gular teeth, contains a single rare species (*Elachistodon westermanni*), of which hitherto only two specimens, both from Bengal, have been recorded. Of the other two sub-families, one, the *Homalopsinae*, consists of water snakes, chiefly inhabiting estuaries, though some are found in large rivers and others in the sea. They are easily recognized by the position of their nostrils on the upper surface of the snout. The commonest kind is *Cerberus rhynchops*, which lives in the mud of estuaries and the coast, and feeds on fish. The other sub-family (*Dipsadinae*) contains several Indian snakes belonging to the genera *Dipsadomorphus* (*Dipsas*), *Psammophis*, *Dryophis*, *Chrysopelea*, and others, some of which are locally common. One of those most frequently seen is the very slender *Dryophis mycterizans*, sometimes called 'whip snake,' which is found in grass or bushes, twined among the stems.

The poisonous Colubrine snakes belong to two sub-families, the *Hydrophiinae* and the *Elapinae*. The *Hydrophiinae* are sea snakes, and are commonly seen swimming in the sea near the coast; they abound all round India, and some kinds enter tidal streams. Some twenty-seven Indian species are known, but most of them are rare. The *Elapinae* include the Cobra (*Naia tripudians*), one of the commonest and most deadly of Indian snakes; the larger Cobra or Hamadryas (*N. bungarus*); the *karait* (*Bungarus candidus* or *caeruleus*); and the *rāj-sāmp* (*B. fasciatus*). Cobras are found almost throughout the Empire, and are commonly three to four feet long, though individuals have been measured between five and six feet in length. The hood, formed by the expansion of the neck-skin, is characteristic of the species. The markings on the hood vary. In India generally the 'spectacle-mark,' two ocelli connected by a curved line, is the commonest ornament; but in Bengal and Burma a single large ocellus, often imperfect, is the prevalent marking. Many individuals have the hood unmarked. A black variety of the cobra is common in parts of the Himālayas and in the Malay Peninsula, but the colour is generally greyish-brown above, paler below. The Great Cobra, *Hamadryas* or *Ophiophagus* (*N. bungarus*), is a comparatively rare snake, but more common in Burma than in India. It is often found twelve feet in length, sometimes even thirteen. The colour is olive-brown with darker or paler cross-bands; the young are black with yellow rings. This cobra feeds principally upon other snakes, and has the reputation of being excessively fierce and aggressive. The *karait* grows to about

4½ feet in length; it is dark-brown or bluish-black above, reticulated with white streaks. The *rāj-sāmp* or King-snake is larger, being frequently six feet or more in length, and is a very handsome snake banded alternately black and yellow. It, like the Great Cobra, lives upon other snakes. The *karait* is common in most parts of India but rare in Burma; the *rāj-sāmp* is met with very rarely in Southern India, more frequently in Bengal and Burma. Four other species of *Bungarus* are found in parts of India or Burma, and a few more venomous Colubrines are locally distributed.

These, however, are not the only poisonous Indian serpents, for there are also the Viperine snakes to be mentioned. These are the typical venomous forms with, as a rule, broad flat heads, and large canaliculate erectile fangs in front of the upper jaw. Representatives are found in India of the true Vipers (*Viperinae*) and also the Pit Vipers (*Crotalinae*). Among the former, Russell's Viper (*Vipera russellii*), known also as Chain-viper and Cobra monil in Southern India, and as *tic-polonga* in Ceylon, is the most important and dangerous; it grows to about 4 feet in length, but it is considerably thicker than a cobra, and is handsomely marked with rows of large ocelli down the back and sides. It is a snake of very sluggish habits. The only other species of importance is *Echis carinata*, a small snake, rarely exceeding 2 feet in length, but very fierce and venomous. It is common in North-western India, where it is known as the Kappa, and in the Konkan; less common in other parts of the Peninsula, and not found east of the Bay of Bengal.

The Crotaline sub-family or Pit Vipers, to which the American rattlesnakes belong, are distinguished by having a deep loreal pit between the nostril and the eye. The Indian representatives are two species of *Ancistrodon* (*Halys*), one found in the Himālayas, the other in the Western Ghāts and Ceylon, and ten species of *Lachesis* (*Trimeresurus*), mostly confined to the hill forests. Several of the latter are of a green colour and are arboreal in habit. Although they attain a length in some cases of 3 to 4 feet, none of them appears to cause death in man by their bite.

Batrachians

The Batrachians are divided into three Orders: (1) *Ecaudata*, or Frogs and Toads; (2) *Caudata*, or Newts and Salamanders; and (3) *Apoda*, or Caecilians. All are found in India, but the first alone is represented by numerous species.

Not only are the frogs and toads of India numerous—the number known in 1901 was 22 genera and 134 species—but their distribution is of considerable interest. As in the case of the Reptilia, the Himālayan genera are few in number, only 6 being found in those mountains, and only one of these is peculiar to the area, while 14 genera occur in Peninsular India and Ceylon, and of these one half are not known to exist elsewhere. All of the peculiar forms inhabit the Malabar and Ceylon hills, which have perhaps the richest Ecaudate Batrachian Fauna in the world. In Burma with Assam 14 genera also occur, of which 7 are not found in Peninsular India or Ceylon. Ecaudata.

The majority of the species belonging to the various genera are small and rare; the number of kinds often met with is not great. Among the commonest is a small species of frog which is found all over the country about ponds and marshes, and which attracts attention by its peculiar habit, when alarmed, of jumping along the surface of the water. In books of natural history this habit is wrongly attributed to *Rana tigrina*, a large frog with rather short webs to the toes; but the jumper is really a much smaller species (*R. cyanophlyctis*), the body of which is from 2 to 2½ inches long and the toes fully webbed. Another common small species, with half-webbed toes, and less aquatic than *R. cyanophlyctis*, is *R. limnocharis*. *R. tigrina* is a fairly common frog, measuring 6 inches in length; it is often found at some distance from water, and is said occasionally to devour young ducks and chickens. Another frog that is not uncommon in Peninsular India and Ceylon is the 'Chunam frog' of Madras (*Rhacophorus maculatus*). This is one of the frogs distinguished by having the tips of the fingers and toes expanded, an arrangement which, by increasing the power of the animal to cling to inclined or vertical surfaces, enables it to climb trees or rocks. This expansion of the finger and toe-tips is also found in several Indian kinds of typical *Rana*, which is distinguished from *Rhacophorus* by wanting the intercalary ossification between the penultimate and distal phalanges of the digits characteristic of the latter. Another genus of tree-frogs well represented in the hills of Southern India and Ceylon, and distinguished from *Rhacophorus* by the want of vomerine teeth, is *Ixalus*, among the members of which some species, one of them occurring on the Nīlgiris, have become well known by their 'peculiar loud clear metallic tinkling call,' as Jerdon described it. The genus *Ixalus* is remarkable for its geographical distribution. No less than fourteen species out of about twenty-five recorded are

peculiar to Southern India and Ceylon, none are known to occur in the Indian Peninsula north of North Kanara (about 15° N. lat.), in Northern India or the Himālayas; the other species are Chinese, Burmese, or Malayan. Another extraordinary instance of distribution is afforded by *Calluella guttulata*, a small peculiarly marked species inhabiting Pegu and Tenasserim, as the whole of the family Dyscophidae, of which this species is a member, with this single exception, is peculiar to Madagascar. The genus *Rhacophorus* is also represented in Madagascar but not in Africa.

One species of true toad (*Bufo melanostictus*) is common throughout India and Burma, and ascends the Himālayas to a considerable elevation. About fifteen other species of *Bufo* have been described from various parts of the Empire. Among the Batrachians somewhat resembling toads are the curious burrowing forms belonging to the genera *Callula*, *Cacopus*, and *Glyphoglossus*, with heavy bodies and short limbs. They are but rarely seen, being nocturnal, and they are imperfectly known. They are said to live on ants and termites.

Caudata. Of the tailed Batrachia, to which belong salamanders and newts, only a solitary representative is found within Indian limits. This is *Tylototriton verrucosus*, originally discovered in Yunnan, but afterwards found in the Eastern Himālayas of Sikkim.

Apoda. The curious worm-like, burrowing, apodous Batrachia, the Caecilians, are rare, but their distribution in India is remarkable. The whole Order is irregularly but widely dispersed throughout the tropics, as is frequently the case with groups of animals that were formerly more fully developed and more generally distributed than they now are. Out of the sixteen genera known to exist, three genera, comprising among them five species, are found in British India. All of the species occur in the hills of Malabar, but only two of them, both belonging to one genus (*Ichthyophis*), are found in other parts of the Indo-Malay region, such as Ceylon, the Eastern Himālayas, Burma, and Malaysia. In this case, as in some others, the richness of the Fauna inhabiting the Southern Indian hills is noteworthy.

Fishes

In Day's two volumes, published in 1889, in the *Fauna of British India*, 351 genera and 1,418 species of fishes were enumerated. To those, 86 genera and 200 species were added by Alcock from the collections made by the Marine Survey

steamer *Investigator* up to 1896, the additions consisting chiefly of deep-sea forms. A few more species have been recorded since. Of the whole, 79 genera and 361 species, mostly carps or siluroids, are fresh-water fishes, living in rivers, brooks, ponds, tanks, or marshes. Another large group of fishes inhabit the brackish water of estuaries, creeks, and lagoons; but it is a difficult task to distinguish estuarine types from the truly marine forms on one side, and from fluviatile species on the other. Some fishes are migratory, like the salmon and the common eel in Europe, and pass part of their existence in the sea, part in fresh water; but the number of migratory species in India is not large, though certain kinds are of importance for food.

The fishes of India belong to two sub-classes, Chondropterygii or cartilaginous fishes, and Teleostii or bony fishes. Neither ganoids (Sturgeons, Dipnoans, &c.) nor Cyclostomata (Lampreys and Hags) inhabit Indian waters.

Chondropterygii. The highest Order, comprising the cartilaginous fishes, consists chiefly of sharks, dog fishes, and rays or skates. These forms abound in the Indian seas, and at least one shark (*Carcharias gangeticus*) and one or more rays belonging to the genus *Trygon* ascend the larger rivers far beyond the limits of the tide, rays occurring some hundreds of miles from the sea. All the common tropical sharks and rays are found on the Indian coasts, the most ferocious of the former belonging to the genera *Carcharias* (which comprises the Gangetic Shark) and *Galeocerdo*. The Hammer-headed Sharks (*Zygaena*), with their extraordinary 'T'-shaped heads, are also greatly dreaded, and they are in places very common. The Saw Fishes (Pristidae), with the snout produced into a long flat lamina armed with strong teeth on each side, are said to use their 'saws' as offensive weapons, and are regarded as equally dangerous with the true sharks; as some of them attain a length of 16 feet or more, they are formidable animals. They are classed with the rays and skates. Of this group the commonest members in the Indian seas are the Sting-rays (Trygonidae), generally having a long whip-like tail armed above with one or sometimes two serrated spines. The great Eagle-rays, or 'devil-fish,' said to attain a breadth of 18 feet across, and other smaller forms, are occasionally captured on the Indian coast. The dried fins of both sharks and rays are exported to China, and the flesh of some species is eaten, chiefly by the poorer classes, while oil for commercial purposes is obtained from their livers.

Teleostii. The great majority of living fishes, both fluviatile and marine, are bony fishes, distinguished from the cartilaginous fishes by the more perfect ossification of their skeleton, especially of the vertebrae. The Teleosteans, as arranged by Day in the *Fauna of British India*, comprise five Orders, *Physostomi*, *Acanthopterygii*, *Anacanthini*, *Lophobranchii*, and *Plectognathi*.

Physostomi. In the first Order the fin rays are articulated and not spinose, with the occasional exception of the first rays in the dorsal and pectoral fins. The ventral fins are spineless and are 'abdominal,' being situated behind the pectoral fins. Several important families are included, and among them the two to which most of the Indian fresh-water fishes belong.

Two of the families consist of eels, the Symbranchidae and the Muraenidae. To the former belong three Indian species inhabiting fresh and brackish water; the latter, which are distinguished from the former by anatomical characters, and which include the Common Eel of Europe, the Conger, and the Muraenas, are represented by one Indian fresh-water eel belonging to the same genus (*Anguilla*) as the European species, and by many marine forms of several generic types. Some of these grow to 10 feet in length or even longer, while several of the true Muraenas, which inhabit rocky shores, are beautifully coloured, being spotted or banded. The fresh-water fish most commonly known as an eel in India, the *Mastacembelus* or Spiny Eel, is an Acanthopterygian.

The Siluridae or Cat-fishes are represented in India by thirty-two genera containing 117 species. Most of these inhabit fresh water, and are chiefly found in muddy rivers; a few, however, occur in rapid mountain streams. Several are found in estuaries, and species of *Arius* with a few other kinds are marine. All are scaleless fishes, and the majority have large heads furnished with feelers or barbels; in very many forms the dorsal and pectoral fins are each preceded by a strong osseous spine, which is sometimes venomous. A few species attain a large size. *Wallago attu* and the *gūnch* (*Bagarius yarrellii*) both grow to a length of 6 feet; the latter is sometimes spoken of as the 'fresh-water shark.' A few kinds are good eating, one of the best being the *pafta* or Butterfish (*Callichrous*), but the majority are poor and coarse.

The Carps (Cyprinidae) are even more numerous than the Siluroids, for in Day's account of the Indian fishes no fewer than 36 genera and 230 species are enumerated; of these 9 genera and 46 species belong to the *Cobitidinae* or Loaches. It is very doubtful, however, whether some of the forms which

have received names among both the carps and the cat-fishes are entitled to specific distinction. The Cyprinoids are exclusively inhabitants of fresh water. Nearly all are covered with scales; the mouth in all is toothless, but pharyngeal teeth exist in the throat. All carps are edible, and many are well flavoured, although a considerable proportion are bony. Among the best-known Indian carps are the *rohu* or *rohi* (*Labeo rohita*) and the *catla* (*Catla buchanani*), both common in Northern India but wanting in the south. Both grow to a large size in tanks, the *catla* having been known to attain a length of 6 feet. Other species of *Labeo* abound in all streams, and some of them may be known by their dark colour. The next carp to be mentioned is *Barbus tor*, the famous *mahseer* (? *mahā-sir*, or big head), found in all rapid streams, and growing certainly to 60 or 70 lb. weight, and according to some accounts to 90 lb. Some other allied species of *Barbus* are known from parts of India, and are equally distinguished by the sport they afford to anglers. Other inhabitants of mountain streams belong to the genus *Barilius*; several of the species are spotted and have many of the habits of trout. They are common in Kashmīr and along the Western Ghāts, and are often called 'trout' by sportsmen. Small carp inhabit all streams and rivers in great numbers; some of the best known are called *chilwa* (*Chela*, *Aspidoparia*).

No Salmonidae (salmon, trout, char, grayling, smelts) are known in India or Burma; the nearest locality where any Salmonoid occurs is north of Afghanistān in the upper tributaries of the Oxus.

The Herring family (Clupeidae) are well represented in Indian seas, and to this family belongs the most important species of migratory Indian fish. This is the *hilsa* of Bengal, 'Sable fish' of Southern India, and 'Palla' of the Indus (*Clupea ilisha*), a true shad, closely allied to the Allice Shad of Europe, and bearing, curiously enough, the same name, for there can be little question that the words Ilisha and Allice Shad are identical in origin. The Indian fish, it may be mentioned, is more finely flavoured than its European relative. Another species of herring (*C. longiceps*) is the 'oil-sardine' of the Malabar Coast, largely used in the production of fish oil. Several species of Anchovy (*Engraulis*) also occur on the Indian coasts and in the estuaries, and are largely salted for consumption.

The remaining families of Physostomi are less important. The Notopteridae, very compressed fish, with the anal and

caudal fins confluent, and rudimentary ventrals, contain two fresh-water species only. To the Scopelidae belongs *Harpodon nehereus*, known in the dried state as Bummaloh or 'Bombay duck,' which abounds in parts of the Indian coast, but, as Günther points out, has the appearance of a deep-sea form, like many other members of the family Scopelidae. A second species (*H. squamosus*) has been described from a depth of about 250 fathoms in the Bay of Bengal by Wood-Mason and Alcock, and has quite recently been obtained in the Arabian Sea. The Cyprinodontidae are small fishes inhabiting the sea, brackish and fresh water; five species are Indian. The Scombresocidae comprise the Gar-pikes (*Belone*), with six Indian species, one of them fluviatile; the 'Half-beaks' (*Hemirhamphus*), which are Gar-fish with the lower jaw elongated and the upper short, and include thirteen species, some of them estuarine; and seven species of flying fishes (*Exocoetus*), which abound in the open sea.

Acanthopterygi.

In the next Order, which comprises the large majority of marine fishes, part of the rays in the dorsal, anal, and ventral fins are spiny and not articulated. The families are numerous, and only the more important need be noticed.

The Perch family (Percidae) is one of the largest, 30 genera and 168 species being referred to it from Indian waters. The fresh-water Perch of Europe is not represented, but a genus of small, much compressed, semi-transparent fishes called *Ambassis* is represented in Indian rivers by several species. One of the most valuable food fishes of this family is the estuarine kind called *begti* in Bengal (*Lates calcarifer*), which grows to a weight of 200 lb. Then there are many sea perches of the genera *Serranus*, *Lutjanus*, and their allies, most of which are eaten, though they vary greatly in flavour. Some are beautifully coloured, but in this they are surpassed by members of the next family (Squamipinnes), curiously shaped compressed fishes as high as they are long. One of these (*Heniochus macrolepidotus*) is crossed diagonally by broad curved bands alternately rich-blue and orange. Of course these brilliant colours disappear with the life of the fish.

To the Mullidae, of which the type is the Red Mullet of Europe (*Mullus barbatus*), are referred fourteen fishes found in the Indian seas; but they are held in no estimation by Europeans, although, as they are all near allies of the far-famed European fish, some of them are probably excellent eating. It may, however, be noted that Anglo-Indians are generally very imperfectly acquainted with Indian fishes and

especially with marine species. The Sparidae, or Sea Breams, and Cirrhitidae comprise several edible fishes, especially the members of the genus *Chrysophrys*, one of which (*C. berda*) is known in parts of the Madras Presidency as 'Black Rock Cod.' The Scorpaenidae are very spiny fishes with large heads. The Indian forms are but little eaten; among them are *Synanceia* and its allies, fishes of a repulsive aspect, and justly dreaded on account of the venomous dorsal spines, each of which is grooved and has a small poison-bag attached.

The Nandidae are a small family with one marine genus (*Plesiops*) and three fresh-water genera (*Badis*, *Nandus*, and *Pristolepis*), small perch-shaped fishes, peculiar to India and South-eastern Asia. Passing over the less important Teuthididae, Berycidae, and Kurtidae, the Polynemidae are the next family requiring notice. The Indian representatives consist of eight species belonging to the genus *Polynemus*, distinguished by having lengthened free rays below the pectoral fins. Several of the species enter estuaries, especially *P. paradiseus*, the Mango-fish or *tapsi machchi* of Bengal, one of the most delicious fishes known, which ascends tidal rivers in Bengal and Burma during the south-west monsoon. It is a small fish, not exceeding about 9 inches in length; but *P. indicus* attains 4 feet and *P. tetradactylus* 6 feet or more. Both enter the mouths of rivers, and both are excellent eating. From the air-bladder of the former isinglass is prepared.

The family Sciaenidae contains several species of the genera *Umbrina*, *Sciaena*, *Sciaenoides*, and *Otolithus*. Many of these haunt estuaries, and one or two ascend rivers above tidal waters; nearly all are good to eat, and all furnish isinglass, which is prepared in large quantities from their air-bladders. Of the Xiphiidae or Sword-fishes three species of *Histiophorus* have been obtained on the Coromandel coast, where the large *H. gladius* is common in the cold season. The Scabbard-fishes (Trichiuridae) and Lancet-fishes (Acanthuridae) are common, but of no great importance; but the Carangidae, containing the Horse-mackerels (*Caranx*) and their allies, are among the most important food fishes of the Indian seas, on account of their abundance and the excellence of their flesh. Besides twenty-six Indian species of *Caranx*, the Pilot-fish (*Naucrates ductor*), well-known as an attendant on sharks, and the remarkable genus *Platax*, the members of which are known as 'Sea-bats' on account of their peculiar deep compressed form and their enormously developed and pointed dorsal and anal fins, belong to the Carangidae.

The family Stromateidae contains the Pomfrets, which approach *Platax* in shape. The three Indian species are highly esteemed as food. The commonest species (*Stromateus cinereus*) is known as 'Silver Pomfret' when young and as 'Gray Pomfret' when adult. The White Pomfret (*S. sinensis*) is regarded as even superior in flavour. The so-called Dolphins (Coryphaenidae) are common at times on the Coromandel coast. The Mackerel family (Scombridae) contains several well-known and valuable Indian fishes, among which are three species of true Mackerel (*Scomber*), the Tunny (*Thynnus*), the Bonito (*T. pelamys*), and Seer fishes (*Cybium*), all excellent food either fresh or salted. The Tunny of the Indian seas is identical with the famous Mediterranean fish.

Amongst the next families recorded in the *Fishes of India* the only form worthy of notice is *Sillago sihama*, known as 'Whiting' in Madras, which is a member of the Trachinidae. In Calcutta the fish known as 'Whiting' is *Sciaenoides pama*, a species of the Sciaenidae. Neither has any affinity to the whiting of Western Europe, which is a member of the cod family.

The 'Anglers' or 'Fishing Frogs' (Pediculati) are well represented, and several additional species have lately been described from the collections of the Marine Survey steamer *Investigator*. Gobies (Gobiidae) abound on the shores of the sea, several occurring in fresh and brackish water. All are small. Among them the peculiar 'mud-skippers' (*Periophthalmus* and *Boleophthalmus*), small fishes 3 to 8 inches long, with blunt heads and prominent eyes, are common in all estuaries, living chiefly on the mud between tidemarks, and moving by a series of jumps along the surface. 'Dragonets' (Callionymidae) and Blennies (Blenniidae) are other shore fishes, mostly of small size. The Rhynchobdellidae are the Spiny Eels (*Rhynchobdella* and *Mastacembelus*), common in the rivers and estuaries of India and Burma, and easily distinguished from true eels by their spiny fins. They are excellent to eat. The Sphyraenidae are large voracious fishes, sometimes known as 'Barracudas,' and dreaded almost as greatly as sharks are. The Atherinidae are small fishes resembling smelts; they are often captured for food in large numbers. Grey Mullets (Mugilidae), of which numerous species occur in all Indian seas and estuaries, and even in some cases in fresh water, are also extensively caught and eaten.

Several species of *Ophiocephalus* (Ophiocephalidae), called Murrel in Northern India, are found throughout India and Burma, inhabiting rivers, ponds, and marshes. All have peculiar

flattish, snake-like heads. They take live bait, especially a frog, freely, and are good to eat. They have a bronchial cavity, by means of which the blood is oxygenated directly. They gain access to the air by rising to the top of the water if necessary, or by lying on the surface. They die if unable to obtain air. On the other hand they can live for a long time out of water; and they form one of the kinds of fish which exist in dried mud throughout the hot season, and recover when the pond or marsh which had dried up is again flooded in the monsoon.

The Climbing Perch (*Anabas scandens*) and its allies (*Polyacanthus* and *Trichogaster*), belonging to the Labyrinthici, are common in the lower plains of India and Burma, and possess the power of living without water to an even greater extent than the Ophiocephali, as their accessory bronchial cavity is more complicated and contains a peculiar laminated organ. *Anabas* and its allies are small fish. The 'Gourami' (*Osphromenus olfax*) of the Malay Archipelago, which belongs to the same family and has a reputation for delicacy of flavour, attains to a considerable size.

Glyphidodontidae and Labridae are two families of marine fishes found chiefly about corals and rocks. They are consequently not common on the Indian coasts, which are for the most part sandy or muddy; but many species occur on the shores of the Andaman and Nicobar Islands. The general form is percoid, and many of the species are brilliantly coloured.

The last Acanthopterygian family (Chromididae) consists of African and South American fresh-water fishes, of which representatives are found in two Asiatic localities only, the Jordan Valley in Palestine and Southern India with Ceylon. In India three species are found, belonging to the genus *Etroplus*, one of them ranging as far north as Orissa, and being found both in fresh and in brackish water. A closely allied genus (*Paretroplus*) occurs in Madagascar.

Anacanthini.

The only important families in the next Order are the Gadidae and Pleuronectidae. The first contains cod, haddock, whiting, ling, hake, and other important food fishes of the North Atlantic, but is represented in the Indian Ocean only by a small pelagic type (*Bregmaceros macclellandi*). A nearly allied family (Macruridae), not recorded from Indian seas when Day's *Fishes of India* was published, is now represented by twenty species obtained from depths between 100 and 1,400 fathoms. Sixteen species have also been obtained from deep

water of another family (Ophidiidae), of which previously only five were known from the seas of India.

The Pleuronectidae, or Flat Fishes, are numerous; for in addition to the thirty-nine species enumerated by Day, no less than thirty additional forms have been obtained by the *Investigator's* researches. But although several are eaten, none of the species have the high repute attaching to the sole and turbot of the North Atlantic.

Lophobranchii. The Pipe-fishes and Sea-horses are so unlike ordinary fishes that it is not easy at first to recognize their affinities. They are encased in a dermal skeleton, and their gills are not laminated but composed of rounded tufts, while the gill openings are very small. The members of the genus *Hippocampus* have prehensile tails, and attach themselves to seaweed. All are very poor swimmers. Several species are found in Indian seas.

Plectognathi. The 'File-fishes,' 'Globe-fishes,' and their allies are also well represented in the seas of India, and one or two species of *Tetrodon* are found in rivers. Most of the genera are more or less globose in form; and *Tetrodon* has the power of blowing itself out into a ball when removed from the water, thus erecting its dermal spines. The Sea Hedgehog (*Diodon*) bears far larger and stronger spines, and adopts the same method of raising them. The flesh of several species, both of file-fishes like *Balistes* and of *Tetrodon*, is poisonous; but certain kinds are eaten by the Burmese and Andamanese.

In conclusion, it should be mentioned that the Lancelet (*Branchiostoma* or *Amphioxus*), the lowest of fishes, without head or brain, and placed by many naturalists in a distinct class, is not uncommon in the seas around India. It is in fact almost cosmopolitan.

W. T. BLANFORD.

CHAPTER VI

ETHNOLOGY AND CASTE[1]

The data of ethnology.

THE modern science of ethnology endeavours to define and classify the various physical types with reference to their distinctive characteristics, in the hope that, when sufficient data have been accumulated, it may be possible in some measure to account for the types themselves, to determine the elements of which they are composed, and thus to establish their connexion with one or other of the great families of mankind. In India, where historical evidence can hardly be said to exist, the data ordinarily available are of three kinds: physical characters, linguistic characters, and religious and social usages. Of these the first are by far the most trustworthy.

Indefinite physical characters.

For ethnological purposes, physical characters may be said to be of two kinds: 'indefinite,' which can only be described in more or less appropriate language; and 'definite,' which admit of being measured and reduced to numerical expression. The former class, usually called descriptive or secondary characters, includes such points as the colour and texture of the skin; the colour, form, and position of the eyes; the colour and character of the hair; and the form of the face and features. Conspicuous as these traits are, the difficulty of observing, defining, and recording them is extreme. Colour, the most striking of all, is perhaps the most evasive.

Colour of skin.

The skin of the Indian peoples exhibits extreme divergences of colouring. At one end of the scale we have the dead black of the Andamanese, and the somewhat brighter black of the Dravidians of Southern India. At the other end one may place the flushed ivory of the traditional Kashmīri beauty, and the very light transparent brown—'wheat-coloured' is the common vernacular description—of the higher castes of Northern India, which is hardly darker than that met with in

[1] This chapter has been abridged, with the assistance of the author, from the chapter on 'Caste, Tribe and Race' contributed by Mr. H. H. Risley, C.S.I., C.I.E., to the *Report on the Census of India*, 1901.

members of the swarthier races of Southern Europe. Between these extremes we find countless shades of brown, darker or lighter, transparent or opaque, frequently tending towards yellow, more rarely approaching a reddish tint, and occasionally degenerating into a sort of greyish black. It would be a hopeless task to register and classify these variations. Nor, if it were done, should we be in a position to evolve order out of the chaos of tints. For even in the individual, minute gradations of colour are comparatively unstable, and are liable to be affected not only by exposure to sun and wind, but by differences of temperature and humidity. Natives of Bengal have stated that people of their race, one of the darkest in India, become appreciably fairer when domiciled in Hindustān or the Punjab, and the converse process may be observed in natives of Northern India living in the damp heat of the Ganges delta.

Hair and eyes.

Little variety is traceable in the character of the eyes and hair. From one end of India to the other the hair of the great mass of the population is black or dark brown, while among the higher castes the latter colour is occasionally shot through by something approaching a tawny shade. Straight hair seems on the whole to predominate, but the wavy or curly character appears in much the same proportion as among the races of Europe. The Andamanese have woolly or frizzly hair, oval in section and curling on itself so tightly that it seems to grow in separate spiral tufts, while in fact it is quite evenly distributed over the scalp. Although the terms woolly and frizzly have been loosely applied to the wavy hair not uncommon among the Dravidians, no good observer has as yet found among any of the Indian races a head that could be correctly described as woolly. The eyes are almost invariably dark brown. Occasional instances of grey eyes are, however, found among the Konkanasth Brāhmans of Bombay; and the combination of blue eyes, auburn hair, and reddish blonde complexion is met with on the north-western frontier. On the Malabar coast Mr. Thurston has noticed several instances of pale blue and grey eyes combined with a dark complexion.

Definite physical characters. Craniometry and anthropometry.

When we turn to the definite, or anthropometric, characters, we find ourselves upon firmer ground. In the early days of anthropology, it was natural that the attention of students should have been directed mainly to the examination of skulls. Craniometry seemed to offer a solution of the problems regarding the origin and antiquity of the human race which then divided the scientific world. Its precise method promised to clear up the mystery of the prehistoric skulls discovered in the

quaternary strata of Europe, and to connect them on the one side with a possible simian ancestor of mankind, and on the other with the races of the present day. This line of research led on to the measurements of living subjects, which have since been undertaken by a number of inquirers. Anthropometry, which deals with living people, while craniometry is concerned exclusively with skulls, possesses certain advantages over the elder science. For reasons too technical to enter upon here, its procedure is in some respects less precise, and its results less minute and exhaustive, than those of craniometry. These minor shortcomings are, however, amply made up for by its incomparably wider range. The number of subjects available is practically unlimited; measurements can be undertaken on a scale large enough to eliminate not merely the personal equation of the measurer, but also the occasional variations of type arising from intermixture of blood; and the investigation is not restricted to the characters of the head, but extends to the stature and the proportions of the limbs. A further advantage arises from the fact that no doubts can arise as to the identity of the individuals measured. In working with skulls this last point has to be reckoned with. The same place of sepulture may have been used in succession by two different races; and the skulls of conquering chiefs may be mixed with those of alien slaves, or of prisoners slain to escort their captors to the world of the dead. The savage practice of head-hunting may equally bring about a deplorable confusion of cranial types; skulls picked up in times of famine may belong to people who have wandered from no one knows where; and even hospital specimens may lose their identity in the process of cleaning.

Anthropometry in India.

Scientific anthropometry was introduced into India on a large scale in 1886, in connexion with the Ethnographic Survey of Bengal then in progress. The survey itself was a first attempt to apply to Indian ethnography the method of systematic research sanctioned by the authority of European anthropologists. Among these the measurement of physical characters occupies a prominent place; and it seemed that the restrictions on intermarriage which are peculiar to the Indian social system would favour this method of observation, and would enable it to yield peculiarly clear and instructive results. A further reason for resorting to anthropometry was the fact that the wholesale borrowing of customs and ceremonies which goes on among the various social groups in India makes it practically impossible to arrive at any certain conclusions by

examining these practices. Finally, the necessity of employing more precise methods was accentuated by Mr. Nesfield's[1] uncompromising denial of the truth of 'the modern doctrine which divides the population of India into Aryan and aboriginal'; and his assertion of the essential unity of the Indian race, enforced as it was by the specific statements that 'the great majority of Brāhmans are not of lighter complexion, or of finer and better bred features, than any other caste,' and that a stranger walking through the class-rooms of the Sanskrit College at Benares 'would never dream of supposing' that the high caste students of that exclusive institution 'were distinct in race and blood from the scavengers who swept the roads.' A theory which departed so widely from the current beliefs of the people, and from the opinions of most independent observers, called for the searching test which anthropometry promised to furnish, and the case was crucial enough to put the method itself on its trial. The experiment has been justified by its results.

The data now available.

In 1890 Mr. H. H. Risley published in the *Journal of the Anthropological Institute*[2], under the title 'The Study of Ethnology in India,' a summary of the measurements of eighty-nine characteristic tribes and castes of Bengal, the United Provinces, and the Punjab. These measurements were taken in accordance with a scheme approved by the late Sir William Flower of the British Museum and Professor Topinard of Paris. Topinard's instruments were used and his instructions were closely followed throughout. Analysis of the data rendered it possible to distinguish, in the area covered by the experiment, three main types, which were named provisionally Aryan, Dravidian, and Mongoloid. The characteristics of these types will be discussed below. Here it is sufficient to remark that the classification was accepted by Flower, Beddoe, and Haddon in England; by Topinard in France; and by Virchow, Schmidt, and Kollmann in Germany. It has recently been confirmed by the high authority of Sir William Turner, who has been led by the examination of a large number of skulls to the same conclusions that were suggested to Mr. Risley by measurements taken on living subjects. Similar confirmation is furnished by the craniometric researches of Colonel Havelock Charles in the Punjab. Great additions have been made to the number of measurements on living subjects by the exertions of

[1] Nesfield's *Brief View of the Caste System of the North-Western Provinces and Oudh*.

[2] *J.A.I.*, xx. 235.

Mr. Edgar Thurston, Superintendent of Ethnography, Madras; by Mr. T. H. Holland, Director of the Geological Survey of India, who has contributed important data for the Coorgs and Yeravas of Southern India, and the Kanets of Kulū and Lāhul; by Messrs. K. B. Samanta and B. A. Gupte, who have carried out under Mr. Risley's instructions an extensive series of measurements in Baluchistān, Rājputāna, Bombay, and Orissa; and by Colonel Waddell, of the Indian Medical Service, who has published some most valuable data for Assam and parts of Bengal in the *Journal of the Asiatic Society of Bengal*[1]. It must be added that the conclusions based on these investigations are necessarily provisional, and will be of use mainly as a guide to research and as an indication of the progress made up to date (1905) in this line of inquiry. During the next few years the data will be greatly added to by the Ethnographic Survey of India still in progress, and we may then hope to make some approach to a final classification of the people of India on the basis of their physical characters.

Conditions favourable to anthropometry in India.

It is easy enough to distinguish certain well-marked physical types. Our difficulties begin when we attempt to carry the process farther, and to differentiate the minor types or sub-types which have been formed by varying degrees of intermixture. The extremes of the series are sharply defined; but the intermediate types melt into each other, and it is hard to say where the dividing line should be drawn. Here measurements are of great assistance, especially if they are arranged in a series so as to bring out the relative preponderance of certain characters in a large number of the members of particular groups. We are further assisted by the remarkable correspondence that may be observed at the present day, in all parts of India except the Punjab, between variations of physical type and differences of grouping and social position. This, of course, is due to the operation of the caste system. Nowhere else in the world do we find the population of a large sub-continent broken up into an infinite number of mutually exclusive aggregates, the members of which are forbidden by an inexorable social law to marry outside the group to which they themselves belong. Whatever may have been the origin and the earlier developments of caste, this absolute prohibition of mixed marriages stands forth now as its essential and most prominent characteristic. In a society thus organized, a society putting an extravagant value on pride of blood and the idea of ceremonial purity, differences of physical type, however produced in the first instance, may be ex-

[1] *J. A. S. B.*, vol. lxix, part iii, 1900.

pected to manifest a high degree of persistence, while methods which seek to trace and express such differences find a peculiarly favourable field for their operations. In this respect India presents a remarkable contrast to most other parts of the world, where anthropometry has to confess itself hindered, if not baffled, by the constant intermixture of types, obscuring and confusing the data ascertained by measurements. All the recognized nations of Europe are the result of a process of unrestricted crossing, which has fused a number of distinct tribal types into a more or less definable national type. In India the process of fusion was long ago arrested, and the degree of progress which it had made up to the point at which it ceased to operate is expressed in the physical characteristics of the groups which have been left behind. There is consequently no national type, and no nation in the ordinary sense of the word.

Measurement of head-form.

The measurements themselves require a few words of explanation. The form of the head is ascertained by measuring in a horizontal plane the greatest length from a definite point on the forehead (the glabella) to the back of the head, and the greatest breadth a little above the ears. The proportion of the breadth to the length is then expressed as a percentage called the cephalic index. Heads with a proportionate breadth of 80 per cent. and over are classed as broad or brachy-cephalic; those with an index under 80, but not under 75, are called medium heads (meso- or mesati-cephalic); long or dolicho-cephalic heads are those in which the ratio of breadth to length is below 75 per cent.

Its value as a test of race.

It is not contended that these groupings correspond to the primary divisions of mankind. Long, broad, and medium heads are met with in varying degrees of preponderance among the white, black, and yellow races. But within these primary divisions the proportions of the head serve to mark off important groups. Topinard shows how the form expressed by the index separates the long-headed Scandinavian people from the broad-headed Celts and Slavs, while the Esquimaux are distinguished on similar grounds from the Asiatic Mongols, and the Australians from the Negritos. All authorities agree in regarding the form of the head as an extremely constant and persistent character, which resists the influence of climate and physical surroundings, and (having nothing to do with the personal appearance of the individual) is not liable to be modified by the action of artificial selection. Men choose their wives mainly for their faces and figures, and a long-headed woman offers no

greater attractions of external form and colouring than her short-headed sister. The intermixture of races with different head-forms will of course affect the index, but even here there is a tendency to revert to the original type when the influence of crossing is withdrawn. On the whole, therefore, the form of the head, especially when combined with other characters, is a good test of racial affinity. It may be added that neither the shape nor the size of the head seems to bear any direct relation to intellectual capacity.

Head-form in India.

Compared with the rest of Asia, India may be described as mainly an area of long-headed people, separated by the Himālayas and its offshoots from the Mongolian country, where the broad-headed types are more numerous and more pronounced than anywhere else in the world. At either end of the mountain barrier broad heads are strongly represented, in Assam and Burma on the east, and in Baluchistān on the west; and the same character occurs in varying degrees in the Lower Himālayas, and in a belt of country on the west of India, extending from Gujarāt through the Deccan to Coorg, the precise limits of which it is not yet possible to define. In the Punjab, Rājputāna, and the United Provinces long heads predominate, but the type gradually changes as we travel eastward. In Bihār medium heads prevail on the whole, while in certain of the Bengal groups a distinct tendency towards brachy-cephaly may be observed, which shows itself in the Muhammadans and Chandāls of Eastern Bengal, is more distinctly marked in the Kāyasths, and reaches its maximum development among the Bengal Brāhmans. South of the Vindhyas the prevalent type seems to be mainly long-headed or medium-headed, short heads appearing only in the western zone referred to above. The coast population has been much affected by foreign influence—Malayan or Indo-Chinese on the east; Arab, Persian, African, European, and Jewish on the west; and the mixed types thus produced cannot be brought under any general formula.

Measurement of the nose.

The proportions of the nose are determined on the same principle as those of the skull. The height and the breadth are measured from certain specified points, and the latter dimension is expressed as a percentage of the former. The nasal index, therefore, is simply the relation of the breadth of the nose to its height. If a man's nose is as broad as it is high, no infrequent case among the Dravidians, his index is 100. The results thus obtained are grouped in three classes—narrow or fine noses (leptorrhine), in which the width is less than 70 per cent. of the height; medium noses (mesorrhine), with an

index of from 70 to 85; and broad noses (platyrrhine), in which the proportion rises to 85 per cent. and over. Where races with different nasal proportions have intermingled, the index marks the degree of crossing that has taken place; it records a large range of variations; and it enables us to group types in a serial order corresponding to that suggested by other characters. For these reasons the nasal index is accepted by all anthropologists as one of the best tests of racial affinity.

The nasal index in India.

Speaking generally, it may be said that the broad type of nose is most common in Madras, the Central Provinces, and Chotā Nāgpur; that fine noses in the strict sense of the term are confined to the Punjab and Baluchistān; and that the population of the rest of India tends to fall within the medium class. But the range of the index is very great: it varies in individual cases from 122 to 53, and the mean indices of different groups differ considerably in the same part of the country. The average nasal proportions of the Māl Pahāriā tribe of Bengal are expressed by the figure 94·5, while the pastoral Gūjars of the Punjab have an index of 66·9 and the Sikhs of 68·8. In other words, the typical Dravidian, as represented by the Māl Pahāriā, has a nose as broad in proportion to its length as the Negro, while this feature in the Indo-Aryan group can fairly bear comparison with the noses of sixty-eight Parisians, measured by Topinard, which gave an average of 69·4. Even more striking is the curiously close correspondence between the gradations of racial type indicated by the nasal index and certain of the social data ascertained by independent inquiry. If we take a series of castes in Bengal, Bihār, the United Provinces, or Madras, and arrange them in the order of the average nasal index, so that the caste with the finest nose shall be at the top and that with the coarsest nose at the bottom of the list, it will be found that this order substantially corresponds with the accepted order of social precedence. Nor is this the only point in which the two sets of observations, the social and the physical, bear out and illustrate each other. The character of the curious matrimonial groupings for which the late Mr. J. F. McLennan devised the useful term exogamous also varies in a definite relation to the gradations of physical type. Within a certain range of nasal proportions, these subdivisions are based almost exclusively on the totem. Along with a somewhat finer form of nose, groups called after villages and larger territorial areas, or bearing the name of certain tribal or communal officials, begin to appear; and above these again we reach the eponymous saints and heroes who in

Its correspondence with social groupings.

India, as in Greece and Rome, are associated with a certain stage of Aryan progress.

The comparative flatness of the Mongolian face is a peculiarity which cannot fail to strike the most casual observer. On closer examination this characteristic will be seen to be closely connected with the formation of the cheek-bones, the margins of the bony sockets of the eyes, and the root of the nose. No precise measurements can be made of the cheek-bones on the living subject, for it is impossible to fix any definite points from which the dimensions can be taken. Some years ago, however, Mr. Oldfield Thomas devised a method of measuring the relative projection of the root of the nose above the level of the eye-sockets, which expresses very accurately the degree of flatness of face met with in different types. It was used by him for skulls; but it has the great advantage of being equally applicable to living persons, and, at Sir William Flower's suggestion, it has been extensively used in India, especially among hill tribes and wherever there was reason to suspect an intermixture of Mongolian blood. The procedure adopted is to mark a point on the front surface of the outer edge of each orbit, and a third point on the centre of the root of the nose where it is lowest. The distance between the two orbital dots is then measured in a direct line, and also the distance from each of these to the dot on the bridge of the nose. The former dimension represents the base of a triangle, the latter its two sides. The index is formed by calculating the percentage of the latter breadth on the former. If, as is sometimes the case, the bridge of the nose is let down so low that it does not project at all beyond the level of the orbits, the two dimensions will obviously be of equal length and the index will be 100. If, on the other hand, the elevation of the bridge of the nose is marked, the index may be as high as 127 or 130. Experience gained in India, which extends to a large number of castes and tribes in all parts of the country, has led Mr. Risley to adopt, on the indices thus obtained, the following grouping for the living subject:—

The orbito-nasal index: a test of Mongolian affinities.

Platyopic	below 110.
Mesopic	110 to 112·9.
Pro-opic	113 and over.

This brings the Mongoloid people of Assam and the Eastern Himālayas within the platyopic group, and effectually differentiates them from the broad-headed races of Baluchistān, Bombay, and Coorg. It also separates the Indo-Aryans from the Aryo-Dravidians.

Stature in Europe and India.

Topinard's classification of stature, which is generally accepted, comprises four groups whose height in feet and inches is as below :—

Tall statures . . .	5′ 7″ and over.
Above average . .	between 5′ 5″ and 5′ 7″.
Below average . .	between 5′ 3″ and 5′ 5″.
Short statures . .	less than 5′ 3″.

Much has been written on the subject of the causes which affect the stature. The general conclusion seems to be that in Europe the influence of race is to a great extent obscured by other factors, such as climate, soil, elevation, food-supply, habits of life, occupation, and natural or artificial selection. Most of these causes also come into play in India, but not necessarily to the same extent as in Europe. The influence of city life, which in civilized countries tends to reduce the stature and to produce physical degeneracy, is relatively small in India, where the great majority of the population are engaged in agriculture. Nor are the conditions of factory industries so trying, or so likely to affect growth, as in Europe. Some of the indigenous hand-loom weavers, however, show the lowest mean stature yet recorded, a fact which is probably due to the unwholesome conditions in which they live. In India, as in Europe, dwellers in the hills are generally shorter than the people of the plains; and within the hill region it may in both countries be observed that the stature is often greater at high than at moderate altitudes, a fact which has been ascribed to the influence of rigorous climate in killing off all but vigorous individuals. In India, too, the prevalence of malaria at the lower levels would probably tend to bring about the same result. On the whole, however, the distribution of stature in India seems to suggest that race differences play a larger part here than they do in Europe. The tallest statures are found in Baluchistān, the Punjab, and Rājputāna; and a progressive decline may be traced down the valley of the Ganges, until the lowest limit is reached among the Mongoloid people of the hills bordering on Assam. In the south of India the stature is generally lower than in the plains of the north. The minimum is found among the Negritos of the Andaman islands, whose mean stature is given by Deniker as 4 feet 10½ inches.

The seven main physical types of India.

The physical data above discussed enable us to divide the people of the Indian Empire into seven main physical types. If we include the Andamanese, the number of types would be eight, but for our present purpose this tiny group of Negritos may

be disregarded. Counting from the north-western frontier, the main types are as follows:—

I. The *Turko-Irānian*, represented by the Baloch, Brāhui, and Afghāns of Baluchistān and the North-west Frontier Province. Probably formed by a fusion of Turkī and Persian elements, in which the former predominate. Stature above mean; complexion fair; eyes mostly dark, but occasionally grey; hair on face plentiful; head broad; nose moderately narrow, prominent, and very long. The feature in these people that strikes one most prominently is the portentous length of their noses, and it is probably this peculiarity that has given rise to the tradition of the Jewish origin of the Afghāns.

II. The *Indo-Aryan*, occupying the Punjab, Rājputāna, and Kashmīr, and having as its characteristic members the Rājputs, Khattrīs, and Jāts. This type, which is readily distinguishable from the Turko-Irānian, approaches most closely to that ascribed to the traditional Aryan colonists of India. The stature is mostly tall; complexion fair; eyes dark; hair on face plentiful; head long; nose narrow and prominent, but not specially long.

The most important points to observe in the Indo-Aryan measurements are the great uniformity of type, and the very slight differences between the higher and the lower groups. Socially no gulf can be wider than that which divides the Rājput of Udaipur from the scavenging Chuhrā of the Punjab. Physically the one is cast in much the same mould as the other; and the difference in mean height which the seriations disclose is no greater than might easily be accounted for by the fact that, in respect of food, occupation, and habits of life, the Rājput has for many generations enjoyed advantages denied to the Chuhrā. Stature we know to be peculiarly sensitive to external influences of this kind. Other and more subtle influences react upon environment and tend to modify the type: thus Sikhism has transformed the despised Chuhrā into the soldierly Mazhabi.

III. The *Scytho-Dravidian*, comprising the Marāthā Brāhmans, the Kunbīs, and the Coorgs of Western India. Probably formed by a mixture of Scythian and Dravidian elements. This type is clearly distinguished from the Turko-Irānian by a lower stature, a greater length of head, a higher nasal index, a shorter nose, and a lower orbito-nasal index. All of these characters, except perhaps the last, may be due to a varying degree of intermixture with the Dravidians. In the higher

groups the amount of crossing seems to have been slight; in the lower the Dravidian elements are more pronounced.

IV. The *Aryo-Dravidian, or Hindustāni*, found in the United Provinces, in parts of Rājputāna, and in Bihār, and represented in its upper strata by the Hindustāni Brāhman and in its lower by the Chamār. Probably the result of the intermixture, in varying proportions, of the Indo-Aryan and Dravidian types. The head-form is long, with a tendency to medium; the complexion varies from lightish brown to black; the nose ranges from medium to broad, being always broader than among the Indo-Aryans; the stature is lower than in the latter group, and usually below the average according to the scale given on p. 292. The higher representatives of this type approach the Indo-Aryans, while the lower members are in many respects not very far removed from the Dravidians. The type is essentially a mixed one, yet its characteristics are readily definable, and no one would take even an upper-class Hindustāni for a pure Indo-Aryan, or a Chamār for a genuine Dravidian. The distinctive feature of the type, the character which gives the real clue to its origin and stamps the Aryo-Dravidian as racially different from the Indo-Aryan, is to be found in the proportions of the nose. The average index runs in an unbroken series from 73·0 in the Bhuinhār of Hindustān, and 73·2 in the Brāhman of Bihār, to 86 in the Hindustāni Chamār and 88·7 in the Musahār of Bihār. The order thus established corresponds substantially with the scale of social precedence independently ascertained.

V. The *Mongolo-Dravidian or Bengali* type of Lower Bengal and Orissa, comprising the Bengal Brāhmans and Kāyasths, the Muhammadans of Eastern Bengal, and other groups peculiar to this part of India. Probably a blend of Dravidian and Mongoloid elements, with a strain of Indo-Aryan blood in the higher groups. The head is broad; complexion dark; hair on face usually plentiful; stature medium; nose medium, with a tendency to broad.

This is one of the most distinctive types in India, and its members may be recognized at a glance throughout the wide area where their remarkable aptitude for clerical pursuits has procured them employment. Within its own habitat the type extends to the Himālayas on the north and to Assam on the east, and probably includes the bulk of the population of Orissa; the western limit coincides approximately with the hilly country of Chotā Nāgpur and Western Bengal. The broad head of the Bengali, of which the mean index varies from 79·0 in the

Brāhman to 83·0 in the Rājbansi Magh, effectually differentiates the type from the Indo-Aryan or Aryo-Dravidian. The seriation of the cephalic index for the Brāhmans of Eastern Bengal is very regular in its gradations, and it presents a striking contrast with the corresponding diagrams for the Hindustāni Brāhmans and the Rājput. Here, as elsewhere, the inferences as to racial affinity suggested by the measurements are in entire accord with the evidence afforded by features and general appearance. For example, it is a matter of common knowledge that the Rājbansi Magh of Chittagong, who is in great demand as a cook in European households in India, resembles the upper-class Bengali of Eastern Bengal so closely that it takes an acute observer to tell the difference between the two. In the Brāhman seriation the finer nasal forms predominate; and it is open to any one to argue that, notwithstanding the uncompromising breadth of the head, the nose-form may in their case be due to the remote strain of Indo-Aryan ancestry to which their traditions bear witness.

VI. The *Mongoloid* type of the Himālayas, Nepāl, Assam, and Burma, represented by the Kanets of Lāhul and Kulū; the Lepchās of Darjeeling and Sikkim; the Limbus, Murmīs, and Gurungs of Nepāl; the Bodo of Assam; and the Burmese. The head is broad; complexion dark, with a yellowish tinge; hair on face scanty; stature short or below average; nose fine to broad; face characteristically flat; eyelids often oblique.

On its northern and eastern frontier India marches with the great Mongolian region of the earth, and a glance at the ethnographic map in the *Gazetteer Atlas* will show how the Indian area on which this particular foreign influence has impressed itself widens gradually from west to east. The Punjab and Hindustān are left virtually untouched; the Bengalis exhibit a type sensibly modified in the direction of Mongolian characters; the Assamese are unmistakably Mongoloid; and in Burma the only non-Mongolian elements are the result of recent immigration from India. This condition of things is of course mainly due to the intervention of the great physical barrier of the Himālayas, which obstructed the southward extension of the Mongolian races. But other causes also enter in. No one who is acquainted with the population of the Lower Himālayas can have failed to observe that in the west there has been a substantial intermixture of Indo-Aryan elements, while in the east the prevailing type down to the verge of the plains is exclusively Mongoloid. The reason seems to be that the warlike races of the Punjab and Hindustān

invaded the pleasant places of the hills, and conquered for themselves the little kingdoms which once extended from the Kashmīr valley to the eastern border of Nepāl. The hill Rājputs of Kāngra and the Khas of Nepāl form the living records of these forgotten enterprises. Farther east the conditions were reversed. Neither Bengalis nor Assamese have any stomach for fighting; they submitted tamely to the periodical raids of the hill people; and the only check upon the incursions of the latter was their inability to stand the heat of the plains. They occupied, however, the whole of the lower ranges, and held the Duārs, or gates, of Bhutān until dispossessed by us. Thus, in the Eastern Himālayas none of the plains people made good a footing within the hills, which remain to this day in the exclusive possession of races of the Mongoloid type.

VII. The *Dravidian* type, extending from Ceylon to the valley of the Ganges, and pervading Madras, Hyderābād, the Central Provinces, most of Central India, and Chotā Nāgpur. Its most characteristic representatives are the Paniyans of Malabar and the Santāls of Chotā Nāgpur. Probably the original type of the population of India, now modified to a varying extent by the admixture of Aryan, Scythian, and Mongoloid elements. In typical specimens the stature is short or below mean; the complexion very dark, approaching black; hair plentiful, with an occasional tendency to curl; eyes dark; head long; nose very broad, sometimes depressed at the root, but not so as to make the face appear flat. This race, the most primitive of the Indian types, occupies the oldest geological formation in India, the medley of forest-clad ranges, terraced plateaux, and undulating plains which stretches, roughly speaking, from the Vindhyas to Cape Comorin. On the east and west of the peninsular area the domain of the Dravidian is conterminous with the Ghāts, while farther north it reaches on one side to the Arāvallis, and on the other to the Rājmahāl Hills. Where the original characteristics have been unchanged by contact with Indo-Aryan or Mongoloid people, the type is remarkably uniform and distinctive. Labour is the birthright of the pure Dravidian: whether hoeing tea in Assam, the Duārs, or Ceylon, cutting rice in the swamps of Eastern Bengal, or doing scavenger's work in the streets of Calcutta, Rangoon, and Singapore, he is recognizable at a glance by his black skin, his squat figure, and the negro-like proportions of his nose. In the upper strata of the vast social deposit which is here treated as Dravidian these typical characteristics tend to thin

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of these types are hidden in the mist which veils the remote era of the Aryan advance into India. Our only guides are tradition and conjecture, aided by the assumption, which the history of the East warrants us in making, that in those distant ages types were formed by much the same processes as those that we find in operation to-day.

The Dravidian type.

The Dravidians probably constitute the oldest of the seven types. Their low stature, black skin, long heads, broad noses, and relatively long forearm distinguish them from the rest of the population of India, and appear at first sight to confirm Huxley's surmise that they may be related to the aborigines of Australia. Linguistic affinities, especially the resemblance between the numerals in Mundāri and in certain Australian dialects, and the survival of some abortive forms of the boomerang in Southern India, have been cited in support of this view; and an appeal has also been made to Sclater's hypothesis of a submerged continent of Lemuria, extending from Madagascar to the Malay Archipelago, and linking India with Africa on the one side and with Australia on the other. But Sir William Turner's comparative study of the characters of Australian and Dravidian crania has not led him to the conclusion that these data can be adduced in support of the theory of the unity of the two peoples. The facts which cast doubt on the Australian affinities of the Dravidians likewise refute the hasty opinion which seeks to associate them with the tiny, broad-headed, and woolly-haired Negritos of the Andamans and the Philippines. This is the last word of scientific authority; and here we might leave the subject, were it not that another theory of the origin of the Dravidians was adopted by Sir William Hunter in the account of the non-Aryan races of India given by him in *The Indian Empire*. According to this view there are two branches of the Dravidians—the Kolārians, speaking dialects allied to Mundāri, and the Dravidians proper, whose languages belong to the Tamil family. The former entered India from the north-east and occupied the northern portion of the Vindhya table-land. There they were conquered and split into fragments by the main body of Dravidians, who found their way into the Punjab through the north-western passes and pressed forward towards the south of India. The basis of this theory is obscure. Its account of the Dravidians proper seems to rest upon a supposed affinity between the Brāhui dialect of Baluchistān and the languages of Southern India, while the hypothesis of the north-eastern origin of the Kolārians depends

on the fancied recognition of Mongolian characteristics among the people of Chotā Nāgpur. But in the first place the distinction between Kolārians and Dravidians is purely linguistic, and does not correspond to any differences of physical type. Secondly, it is extremely improbable that a large body of very black and conspicuously long-headed types should have come from the one region of the earth which is peopled exclusively by races with broad heads and yellow complexions. With this we may dismiss the theory which assigns a trans-Himālayan origin to the Dravidians. Taking them as we find them now, it may safely be said that their present geographical distribution, the marked uniformity of physical characters among the more primitive members of the group, their animistic religion, their distinctive languages, their stone monuments, and their retention of a primitive system of totemism justify us in regarding them as the earliest inhabitants of India of whom we have any knowledge.

The Indo-Aryan type.

Upon the interminable discussions known as the Aryan controversy there is no need to enter here. Whether anything that can properly be described as an Aryan race ever existed; whether the heads of its members were long, according to Penka, or short, according to Sergi; whether its original habitat was Scandinavia, the Lithuanian steppe, South-east Russia, Central Asia, or India itself, as various authorities have held; or again, whether the term Aryan is anything more than a philological expression denoting a heterogeneous group of peoples whose languages belong to the Aryan family of speech—these are questions which may for our present purpose be left unanswered. We are concerned merely with the fact that there now exists in the Punjab and Rājputāna a definite physical type, represented by the Jāts and Rājputs, which is marked by a relatively long (dolicho-cephalic) head; a straight, finely cut (leptorrhine) nose; a long, symmetrically narrow face; a well-developed forehead; regular features; and a high facial angle. The stature is tall, and the general build of the figure is well proportioned, being relatively massive in the Jāts and slender in the Rājputs. Throughout the group the predominant colour of the skin is a very light transparent brown, with a tendency towards darker shades in the lower social strata. Except among the Meos and Mīnās of Rājputāna, where a strain of Bhīl blood may perhaps be discerned, the type shows no signs of having been modified by contact with the Dravidians; its physical characteristics are remarkably uniform; and the geographical conditions of its habitat tend to exclude

the possibility of intermixture with the black races of the south. In respect of their social characters, the Indo-Aryans, as we have here called them, are equally distinct from the bulk of the Indian people. They have not wholly escaped the influence of caste; but its bonds are less rigid here than elsewhere, and the social system retains features which recall the more fluid organization of the tribe. Marriage in particular is not restricted by the hard-and-fast limits which caste tends to impose; but is regulated, within large groups, by the principle of hypergamy, or 'marrying up,' which was supposed to govern the connubial relations of the four original classes (*varna*) in the system described by Manu. Even now Rājputs and Jāts occasionally intermarry, the Rājputs taking wives from the Jāts, but refusing to give their own maidens in return. What is the exception to-day is said to have been the rule in earlier times. In short, both social and physical characters are those of a comparatively homogeneous community which has been but little affected by crossing with alien races.

Its non-Indian origin.

The uniformity of the Indo-Aryan type can be accounted for only by one of two hypotheses—that its members were indigenous to the Punjab, or that they entered India in a compact body, or in a continuous stream of families, from beyond the north-west frontier. It is clear that they cannot have come by sea, and equally clear that they could not have found their way into India round the eastern end of the Himālayas. The theory that the Punjab was the cradle of the Aryan race was propounded by a writer in the Royal Asiatic Society's *Journal*[1] about fifty years ago, on the basis of some rather crude linguistic speculations; but it met with no acceptance, and the opinion of European scholars, from Von Schlegel down to the present time, is unanimous in favour of the foreign origin of the Indo-Aryans. The arguments appealed to are mainly philological. Vedic literature, indeed, as Zimmer[2] admits, throws but scanty light upon the subject, for no great weight can be laid upon the identification of the river Basā with the Araxes, the name by which the Jaxartes was known to Herodotus. We may, however, assume for our present purpose that the ancestors of the Indo-Aryans came into India from the north-west, and that at the time of their arrival the Peninsula, as far as the valley of the Ganges and Jumna, was in the possession of the Dravidians. The only indication of the latter people having extended farther to the west is to be found

[1] *J. R. A. S.*, xvi. 172–200.

[2] Zimmer, *Altindisches Leben*, pp. 15 and 101.

in the survival of Brāhui, an island of supposed Dravidian speech, among the Irānian languages of Baluchistān. But the present speakers of Brāhui are certainly not Dravidians by race, and we find no traces of Dravidian blood among the Indo-Aryans of to-day. It seems probable, therefore, that when the Indo-Aryans entered the Punjab they brought their own women with them: on no other supposition can we explain the comparative purity of their type.

The mode of its entry into India.

Now if the physical and social conditions of the Indian borderland had been the same in those remote ages as we find them at the present day, it is difficult to see how the slow advance of family or tribal migration could have proceeded on a scale large enough to result in an effective occupation of the Punjab. The frontier strip itself, a mere tangle of barren hills and narrow valleys, is ill adapted to serve as an *officina gentium*, while a pastoral people, moving by clans or families from more favoured regions farther west, would have found their way barred by obstacles which only the strongest members of the community could have surmounted. The women and children must have been left behind or they would have perished by the way. Again, given the present rainfall and climate of the countries adjacent to India, where should we find to-day, within a measurable distance of the frontier, the favoured region that would give off the swarm of emigrants required to people the Punjab? Surely not in South-eastern Persia, with its inhospitable deserts of shifting sand; nor on the dreary Central Asian steppes, where only a scanty nomadic population finds a meagre subsistence. But is it certain that, during the three or four thousand years that may have elapsed since the Aryans began to press forward into India, the climate of the countries through which they passed has not undergone a material change? There is a certain amount of evidence in favour of this supposition. Mr. W. T. Blanford, writing in 1873 [1], thought it probable that the rainfall in both Central Asia and Persia had decreased greatly in modern times; and that, owing mainly to this cause, and in a less degree to the destruction of trees and bushes, the climate had become appreciably drier, cultivation had fallen off, and the population had greatly declined in numbers. Nearly thirty years later, we find Mr. Blanford's views confirmed and developed by Mr. E. Vredenburg in his geological sketch of the Baluchistān desert and part of Eastern Persia [2]. Mr. Vredenburg applies to the problem the known

[1] *Quart. Jour. Geol. Soc.*, xxix (1873).
[2] *Mem. Geol. Survey of India*, xxxi, part ii.

principles of physical geography and shows how, given a dwindling rainfall in a tract situated like Eastern Persia and Baluchistān, evaporation is bound to produce the present condition of perennial drought. As the rainfall declines, fertile plains relapse into desert; lakes are transformed into salt marshes; the springs in the hills dry up; and an era of desolation sets in. In illustration of the state of things which must have existed in some former age, Mr. Vredenburg tells us how in the desolate valleys of Khārān (Kalāt State) there exist hundreds of stone walls, known locally as *gabrbands* or 'dams of the infidel,' which mark the edges of ancient terraced fields and retain even now remnants of soil that once was cultivated. Arguing from what one sees in India, it seems likely that these terraced fields represent the overflow of a flourishing agricultural community, driven up into the hills by the pressure of population in the plains. Gradually, as the climate changed, the level alluvial tracts, deprived of rainfall, lapsed into desert; the bulk of the population drifted on into the Punjab; while those who remained behind eked out by pillage the meagre livelihood to be won from patches of soil in the hills. Last of all, the springs on which this scanty cultivation depended shrank and disappeared, till nothing was left but the stone walls to recall the labours of the forgotten people who built them.

The picture, which these observations enables us to construct, of a country of lakes and fertile plains extending from the centre of Persia to the western confines of India, may help to throw light upon the problem of the Indo-Aryan advance into the Punjab. The population of such a tract, as they began to press on their own means of subsistence or were pushed forward by incursions from the west, would naturally have moved on by tribes and families without any disturbance of their social order, and would have occupied the valley of the Indus. Arriving there as an organized society, like the children of Israel when they entered Palestine, they would have had no need to take to themselves any Dravidian daughters of Heth, and they would have preserved their type as distinct as we find it in the Punjab to-day. The movement must of course have been gradual, and must have extended over many centuries, during which time the climate continued to dry up, and the possibilities of agriculture to decline. When the new conditions had become fully established, the north-western frontier of India was closed to the slow advance of family or tribal migration, and remained open only to bands of fighting men or adven-

turous nomads, who could force their way through long zones of waterless deserts ending in a maze of robber-haunted hills. Armed invasion took the place of peaceful colonization. But the invaders, however great their strength, could in any case bring few women in their train. This is the determining factor both of the ethnology and of the history of India. As each wave of conquerors—Greek, Scythian, Arab, Afghān, Mughal—that entered the country by land became more or less absorbed in the indigenous population, their physique changed, their individuality vanished, their energy was sapped, and dominion passed from their hands into those of more vigorous successors.

The Aryo-Dravidians: Dr. Hoernle's theory.

For the origin of the Aryo-Dravidian type, we need not travel beyond the ingenious hypothesis put forward by Dr. Hoernle twenty years ago and confirmed by the recent researches of Dr. Grierson's Linguistic Survey. This theory supposes that after the first swarm of Indo-Aryans had occupied the Punjab, a second wave of Aryan-speaking people, the remote ancestors of the Aryo-Dravidians of to-day, impelled by some ethnic upheaval, or driven forward by the change of climate in Central Asia, made their way into India through Gilgit and Chitrāl and established themselves in the plains of the Ganges and Jumna, the sacred Middle-land (*Madhyadesa*) of post-Vedic tradition. Here they came in contact with the Dravidians; here, by the stress of that contact, caste was evolved; here the Vedas were composed, and the whole fantastic structure of orthodox ritual and usage was built up. The linguistic evidence in favour of this view is summarized in Dr. Grierson's chapter on Language in the *Report on the Census of India*, 1901. For the present purpose it is sufficient to note that the record of physical characters bears out the conclusions suggested by philology. The type of the people now dwelling in the Middle-land is precisely what might have been expected to result from the incursion of a fair long-headed race, travelling by a route which prevented women from accompanying them, into a land inhabited by dark-skinned Dravidians. The men of the stronger race took to themselves the women of the weaker, and from these unions was evolved the mixed type which we find in Hindustān and Bihār. The degree of intermixture necessarily varied: at one end of the scale the type approaches the Indo-Aryan, at the other it almost merges in the Dravidian.

It may be said that the theory of a second wave of Aryans, resting as it does on the somewhat uncertain data of philology, is not really required for the purpose of explaining the facts. Why should we not content ourselves by assuming that the

original Indo-Aryans outgrew their settlements on the Indus, and threw off swarms of emigrants who passed down the Ganges valley, modifying their type as they went by alliances with the Dravidian inhabitants? But on this view of the problem it is difficult to account for the marked divergence of type that distinguishes the people of the Eastern Punjab from those of Western Hindustān. If there had been no second and distinct incursion, coming in like a wedge behind the original colonists, no such sharp contrast would now be discernible. One type would melt into the other by imperceptible gradations, and scientific observation and popular impressions would not concur, as they do, in affirming that a marked change takes place somewhere about the longitude of Sirhind. Nor is this the only point in favour of Dr. Hoernle's hypothesis. It further explains how it is that the Vedic Hymns contain no reference to the route by which the Aryans entered India, or to their earlier settlements on the Indus; and it accounts for the antagonism between the eastern and western sections, and for the fact that the latter were regarded as comparative barbarians by the more cultured inhabitants of the Middle-land.

The Mongolo-Dravidians.

When we leave Bihār and pass eastward into the steamy rice-fields of Bengal, the Indo-Aryan element thins out rapidly and appears only in a sporadic form. The bulk of the population is Dravidian, modified by a strain of Mongoloid blood which is relatively strong in the east and appreciably weaker in the west. Even here, however, where the Indo-Aryan factor is so small as to be hardly traceable, certain exceptions may be noticed. The tradition, cherished by the Brāhmans and Kāyasths of Bengal, that their ancestors came from Kanauj at the invitation of King Adisura to introduce Vedic ritual into an unhallowed region, is borne out to a substantial degree by the measurements of these castes, though even among them indications are not wanting of occasional intermixture with Dravidians. If, however, the regional type is regarded as a whole, the racial features are seen to be comparatively distinct. The physical degeneration which has taken place may be due to the influence of a relaxing climate and an enfeebling diet, and still more perhaps to the practice of marrying immature children, the great blot on the social system of the upper classes of Bengal.

The Scytho-Dravidian type.

Of the foreign elements that have contributed to the making of the Indian peoples two have now been passed in review. We have seen the Indo-Aryan type maintaining a high degree

of purity in the Punjab and Rājputāna, transformed by an increasing admixture of Dravidian blood in Hindustān and Bihār, and vanishing beyond recognition in the swamps of Lower Bengal. We have found the Mongoloid races predominant on the eastern and northern frontiers: confined to the hills where the people of the plains were strong; but farther east, where they came in contact with feebler folk, mixing with the Dravidian element to form the type characteristic of the mass of the population of Bengal and Assam. A third foreign element still remains to be accounted for. It has long been known, mainly from Chinese sources, supplemented by the evidence of coins and the uncertain testimony of Indian tradition, that, long after the settlement of the Indo-Aryans in the Punjab, successive swarms of nomadic people, vaguely designated Sakas or Scythians, forced a way into India from the west, and established their dominion over portions of the Punjab, Sind, Gujarāt, Rājputāna, and Central India. The impulse which started them on their wanderings may be traced in some instances to tribal upheavals in far-distant China, while in other cases bands already on the move were pushed forward from Central Asia. All these peoples came from regions which, so far as we know, have from time immemorial been occupied by broad-headed races.

Historical record of Scythian invasions of India.

In the time of the Achaemenian kings of Persia, the Scythians, who were known to the Chinese as Sse, occupied the regions lying between the lower course of the Sillis or Jaxartes and Lake Balkash. The fragments of early Scythian history which may be collected from classical writers are supplemented by the Chinese annals, which tell us how the Sse, originally located in Southern China, occupied Sogdiana and Transoxiana at the time of the establishment of the Graeco-Bactrian monarchy. Dislodged from these regions by the Yueh-chi, who had themselves been put to flight by the Huns, the Sse invaded Bactriana, an enterprise in which they were frequently allied with the Parthians. To this circumstance, says Ujfalvy, may be due the resemblance which exists between the Scythian coins of India and those of the Parthian kings. At a later period the Yueh-chi made a further advance and drove the Sse or Sakas out of Bactriana, whereupon the latter crossed the Paropamisus and took possession of the country called after them Sakastān, comprising Segistān, Arachosia, and Drangiana. But they were left in possession only for a hundred years, for about 25 B.C. the Yueh-chi disturbed them afresh. A body of Scythians

then emigrated eastward and founded a kingdom in the western portion of the Punjab. The route they followed in their advance upon India is uncertain; but to a people of their habits it would seem that the march through Baluchistān would have presented no serious difficulty.

The Yueh-chi, afterwards known as the Tokhāri, were a power in Central Asia and the north-west of India for more than five centuries, from 130 B.C. The Hindus called them Sakas and Turushkas, but their kings seem to have known no other dynastic title than that of Kushan. The Chinese annals tell us how Kitolo, chief of the Little Kushans, whose name is identified with the Kidāra of the coins, giving way before the incursions of the Ephthalites, crossed the Paropamisus and founded, in the year 425 of our era, the kingdom of Gandhāra, of which, in the time of his son, Peshāwar became the capital. About the same time, the Ephthalites or Ye-tha-i-li-to of the Chinese annals, driven out of their territory by the Yuan-Yuan, started westward and overran in succession Sogdiana, Khwārizm (Khiva), Bactriana, and finally the north-west portion of India. Their movements reached India in the reign of Skanda Gupta (452–80) and brought about the disruption of the Gupta empire. The Ephthalites were known in India as Huns. The leader of the invasion of India, who succeeded in snatching Gandhāra from the Kushans and established his capital at Sākala, is called by the Chinese Laelih, and inscriptions enable us to identify him with the original Lakhan Udayāditya of the coins. His son Toramāna (490–515) took possession of Gujarāt, Rājputāna, and part of the Ganges valley, and in this way the Huns acquired a portion of the ancient Gupta kingdom. Toramāna's successor, Mihirakula (515–44), eventually succumbed to the combined attack of the Hindu princes of Mālwā and Magadha.

Possible origin of the Scytho-Dravidian type.

These are the historical data. Scanty as they are, they serve to establish the fact that, during a long period of time, swarms of nomadic people, whose outlandish names are conveniently summed up in the generic term Scythian, poured into India, conquered, and governed. Their coins are now the sole memorial of their rule, but their inroads probably began centuries before coins were struck or annals compiled. Of the people themselves all traces seem to have vanished, and the student who inquires what has become of them finds nothing more tangible than the modern conjecture that they are represented by the Jāts and Rājputs. But the grounds for this opinion are of the flimsiest description, and consist mainly

of the questionable assumption that the people who are called Jāts or Jats at the present day must have something to do with the people who were known to Herodotus as Getae. Now apart from the fact that resemblances of names are often misleading—witness the Roman identification of these very Getae with the Goths—we have good historical reasons for believing that the Scythian invaders of India came from a region occupied exclusively by broad-headed races and must themselves have belonged to that type. They were by all accounts hordes of horsemen, short and sturdy of stature, and skilled in the use of the bow. In their original homes on the Central Asian steppes their manner of life was that of pastoral nomads, and their instincts were of the predatory order. It seems, therefore, unlikely that their descendants should be found among tribes who are essentially of the long-headed type, tall heavy men without any natural aptitude for horsemanship, settled agriculturists with no traditions of a nomadic and marauding past. Still less probable is it that waves of foreign conquerors, entering India at a date when the Indo-Aryans had long been an organized community, should have been absorbed by them so completely as to take rank among their most typical representatives, while the form of their heads, the most persistent of racial distinctions, was transformed from the extreme of one type to the extreme of another without leaving any trace of transitional forms in the process. Such are the contradictions which beset the attempt to identify the Scythians with the Jāts and Rājputs. The only escape seems to lie in an alternative hypothesis which is suggested by the measurements. These data show that a zone of broad-headed people may still be traced southwards, from the region of the Western Punjab in which we lose sight of the Scythians, right through the Deccan, till it attains its farthest extension among the Coorgs. Is it not conceivable that this may mark the track of the Scythians, who first occupied the great grazing country of the Western Punjab, and then, pressed upon by later invaders and finding their progress eastwards blocked by the Indo-Aryans, turned towards the south, mingled with the Dravidian population, and became the ancestors of the Marāthās? The physical type of the people of this region accords fairly well with this theory, while the arguments derived from language and religion do not seem to conflict with it. For, after entering India, the Scythians readily adopted an Aryan language, written in the Kharosthi character, and accepted Buddhism as their religion. Their Prākrit speech would have

developed into Marāthī, while their Buddhistic doctrines would have been absorbed in that fusion of magic and metaphysics which has resulted in popular Hinduism. On this view the wide-ranging forays of the Marāthās, their guerilla methods of warfare, their unscrupulous dealings with friend and foe, their genius for intrigue and their consequent failure to build up an enduring dominion, might well be regarded as inherited from their Scythian ancestors.

Social divisions: the tribe.

Up to this point we have been dealing with the racial divisions of the people of India, with ethnology properly so called. We now turn to their social divisions, to the ethnographic data as distinguished from the ethnological. These divisions are either tribes or castes, which in their turn are further subdivided, with reference usually to matrimonial considerations. A tribe, as we find it in India, is a collection of families, or groups of families, bearing a common name which, as a rule, does not denote any specific occupation; generally claiming common descent from a mythical or historical ancestor and occasionally from an animal, but in some parts of the country held together rather by the obligations of blood-feud than by the tradition of kinship; usually speaking the same language; and occupying, or claiming to occupy, a definite tract of country. A tribe is not necessarily endogamous, i.e. it is not an invariable rule that a man of a particular tribe must marry a woman of that tribe.

We may distinguish several kinds of tribes in various parts of India; and although it cannot be said that each of the seven racial types has its own distinctive form of tribe, the correspondence between the two sets of groupings is sufficiently close to warrant the conjecture that each type was originally organized on a characteristic tribal basis, and that where tribes have disappeared, their disappearance has been effected by caste insensibly absorbing and transforming the tribal divisions which it found in possession of particular localities. In describing the varieties of tribes we shall therefore follow the ethnic types already determined by physical characters.

The Dravidian tribe.

The Dravidian tribe exists in its most compact and vigorous form among the people of Chotā Nāgpur. Such a tribe is usually divided into a number of exogamous groups, each of which bears the name of an animal or plant common in the locality. Usually, also, there is a distinct village organization, comprising in its most developed forms a headman with his assistant, and a priest, with various acolytes, whose business it is to propitiate the undefined powers from whom physical ills

are to be apprehended. Another remarkable instance of the tribal organization of the Dravidians is to be found among the Khonds of Orissa, once infamous for the human sacrifices which they offered to propitiate the earth goddess, with the object of ensuring good crops and immunity from disease and accidents. The Khonds are divided into fifty *gochis* or exogamous septs, each of which bears the name of a *muta* or village, believes all its members to be descended from a common ancestor, and as a rule dwells in the commune or group of villages after which it is called. The Khond *gochi* appears, therefore, to represent the nearest approach that has yet been discovered to the local exogamous tribe, believed by Mr. McLennan to be the primitive unit of human society.

The Mongoloid tribe.

The Mongoloid type of tribe, as found in the Nāgā Hills, is divided, somewhat on the Khond pattern, into a number of *khels*, each of which is in theory an exogamous group of blood-relations, dwelling apart in its own territory and more or less at war with the rest of the world. Each *khel* fortifies the locality which it inhabits with a stockade, a deep ditch full of bamboo calthrops, and a craftily devised ladder; and raids are constantly made by one upon the other for the purpose of capturing wives. So far as our present researches have gone, no very clear traces have been found of totemism among the Mongoloid races of India; but the Mongoloid people of the Eastern Himālayas and the Chittagong Hills have a singular system of exogamous groups based upon real or mythical ancestors.

The Turko-Irānian tribes: the Afghān type.

Among the Turko-Irānians there seem to be two distinct types of tribe. The first comprises tribes based upon kinship, like the Afghān group of tribes known as Pathāns, or speakers of the Pashtū language. In theory, says Mr. Hughes-Buller[1], 'an Afghān tribe is constituted from a number of kindred groups of agnates. . . . Affiliated with a good many tribes, however, are to be found a certain number of alien groups.' These are not descended from the common ancestor, and the nature of the tie that binds them to the tribe is best expressed in a picturesque phrase which describes them as 'partners for better or worse': in other words, active participators in any blood-feud that the tribe may have on its hands. Yet such is the influence of the idea of kinship upon which the tribe is based, that the alien origin of these groups is admitted with reluctance, and although for matrimonial purposes they are

[1] *Baluchistān Census Report*, 1901.

looked upon as inferior, the tendency is to merge the fact of common vendetta in the fiction of common blood.

The Baloch and Brāhui type.

The second type of Turko-Irānian tribe is based primarily not upon agnatic kinship, but upon common good and ill: in other words, it is cemented together only by the obligations arising from the blood-feud. There is no eponymous ancestor, and the tribe itself does not profess to be composed of homogeneous elements. In the case of the Marri tribe of Baloch, Mr. Hughes-Buller has shown that 'Brāhuis, Baloch from the Punjab, Baloch from other parts of Afghānistān, Khetrāns, Afghāns, Jats, all gained easy admission to the tribe. . . . The process is easy to follow: admission to participation in common blood-feud; then admission to participation in the tribal land; and lastly admission to kinship with the tribe. It was not until after a man or group had been given a share of tribal land at the decennial distribution that women were given to him or them in marriage.' The same principles hold good in the case of the Brāhui, who, like the Baloch, appear by their history and physique to be of Central Asian origin, and whose numbers have been recruited from among Afghāns, Kūrds, Jadgāls, Baloch, and other elements, all probably belonging to the same ethnic stock. Both Baloch and Brāhui possess an elaborate organization for offensive and defensive purposes, based in each case on the principle that the clan, or section, must provide for the service of the tribe a number of armed men proportioned to the share of the tribal land which it holds.

None of the numerous tribes comprised under the names Afghān, Baloch, or Brāhui are strictly endogamous; and stalwart aliens whose services are considered worth having are admitted into the tribe by the gift of a wife, or perhaps one should rather say the loan, for, in the absence of stipulations to the contrary, a woman so given goes back to her own family on the death of her husband. Among the Baloch and Brāhui, however, a distinct tendency towards endogamy results from the practice of marrying a woman of the same group—if possible, a first cousin. This seems to be due partly to the feeling that a woman's marriage to an outsider deprives the tribe of the accession of strength that may accrue to it from her offspring; and partly also, as Mr. Hughes-Buller observes, to the belief that 'while among animals heredity follows the father, among human beings it follows the mother. It is argued, therefore, that there is more hope of the stock remaining pure if a man marries a woman who is nearly related to

him.' In marked contrast to the Baloch and Brāhui, the business instincts of the Afghān lead him to regard women as a marketable commodity, and under the system of *walwar*, or payment for wives, 'girls are sold to the highest bidder, no matter what his social status.'

The word 'caste.'

The word 'caste,' which has obtained such a wide currency in the literature of sociology, comes from the Portuguese adventurers who followed Vasco da Gama to the west coast of India. The word itself is derived from the Latin *castus* and implies purity of breed. In his article on caste in *Hobson-Jobson*, Sir Henry Yule quotes a decree of the sacred council of Goa, dated 1567, which recites how 'the Gentoos divide themselves into distinct races or castes (*castas*) of greater or less dignity, holding the Christians as of lower degree, and keep these so superstitiously that no one of a higher caste can eat or drink with those of a lower.' It was natural enough that foreign observers should seize upon the superficial aspects of a social system which they understood but imperfectly, and should have overlooked the essential fact that the regulations affecting food and drink are comparatively fluid and transitory, while those relating to marriage are remarkably stable and absolute.

Definition of caste.

A caste may be defined as a collection of families or groups of families, bearing a common name which usually denotes or is associated with a specific occupation; claiming common descent from a mythical ancestor, human or divine; professing to follow the same calling; and regarded by those who are competent to give an opinion as forming a single homogeneous community. A caste is almost invariably endogamous in the sense that a member of the large circle denoted by the common name may not marry outside that circle; but within this circle there are usually a number of smaller circles, each of which is also endogamous. Thus, it is not enough to say that a Brāhman at the present day cannot marry any woman who is not a Brāhman: his wife must also belong to the same endogamous division of the Brāhman caste.

Conversion of tribes into castes.

All over India at the present moment we can trace the gradual and almost insensible transformation of tribes into castes. The main agency at work is fiction, which, in this instance, takes the form of the pretence that whatever usage prevails to-day has been so from the beginning of time. It may be hoped that the Ethnographic Survey now in progress will throw much more light upon these singular forms of evolution, by which large masses of people surrender a condition of

quity, is readily distinguishable by its name from any of the standard and recognized castes. Thus the great majority of the Koch inhabitants of Jalpaigurī, Rangpur, and part of Dinājpur now invariably describe themselves as Rājbansis or Bhanga Kshattriyas, a designation which enables them to represent themselves as an outlying branch of the Kshattriyas who fled to North-eastern Bengal in order to escape from the wrath of Parasu Rāma. They claim descent from Rājā Dasaratha, father of Rāma; they keep Brāhmans, imitate the Brāhmanic rituals in their marriage ceremony, and have begun to adopt the Brāhmanical system of *gotras*. In respect of this last point they are now in a curious state of transition, as they have all hit upon the same *gotra* (Kāsyapa) and thus habitually transgress the primary rule of the Brāhmanical system, which absolutely prohibits marriage within the *gotra*. But for this defect in their connubial arrangements—a defect which will probably be corrected in course of time as they and their priests rise in intelligence—there would be nothing in their customs to distinguish them from Indo-Aryan Hindus, although there has been no mixture of blood and they remain thoroughly Koch.

(4) A whole tribe of aborigines, or a section of a tribe, become gradually converted to Hinduism without, like the Rājbanṣis, abandoning their tribal designation. This is what has happened among the Bhumij of Western Bengal. Here a pure Dravidian race have lost their original language and now speak only Bengali; they worship Hindu gods in addition to their own (the tendency being to relegate the tribal gods to the women), and the more advanced among them employ Brāhmans as family priests. They still retain a set of totemistic exogamous subdivisions, closely resembling those of the Mundās and the Santāls; but they are beginning to forget the totems which the names of the subdivisions denote, and the names themselves will probably soon be abandoned in favour of more aristocratic designations. The tribe will then have become a caste in the full sense of the word, and will go on stripping itself of all customs likely to betray its true descent: the physical characteristics of its members will alone survive. With their transformation into a caste, the Bhumij will be more strictly endogamous than they were as a tribe, and even less likely to modify their physical type by intermarriage with other races.

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Types of caste.

By such processes as these, and by a variety of complex social influences whose working cannot be precisely traced,

a number of types or varieties of caste have been formed, which admit of being grouped as follows:—

(i) Tribal castes.

(i) *The tribal type*, where a tribe like the Bhumij has insensibly been converted into a caste, preserving its original name and many of its characteristic customs, but modifying its animistic practices more and more in the direction of orthodox Hinduism, and ordering its manner of life in accordance with the same model. Numerous instances of this process are to be found all over India: it has been at work for centuries, and it has even been supposed that the Sūdras of Indo-Aryan tradition were originally a Dravidian tribe which was thus incorporated into the social system of the conquering race. We may mention as examples of such transformation the Ahīr, Dom, and Dosādh of the United Provinces and Bihār; the Gūjar, Jāt, Meo, and Rājput of Rājputāna and the Punjab; the Kolī and Mahār of Bombay; the Bāgdi, Bauri, Chandāl (Namasūdra), Kaibartta, Pod, and Rājbansi-Koch of Bengal; and, in Madras, the Māl, Nāyar, Vellāla, and Paraiyan (Pariah), of whom the last retain traditions of a time when they possessed an independent organization of their own and had not been relegated to a low place in the Hindu social system.

(ii) Functional castes.

(ii) *The functional or occupational type* of caste is so numerous and so widely diffused, and its characteristics are so prominent, that community of function is ordinarily regarded as the chief factor in the evolution of caste. Almost every caste professes to have a traditional occupation, though many of its members have abandoned it, and the adoption of new occupations, or of changes in the original occupation, may give rise to subdivisions of the caste which ultimately develop into castes entirely distinct. Thus among the large castes, the Ahīrs are by tradition herdsmen; the Brāhmans, priests; the Chamārs and Muchis, workers in leather; the Chuhrās, Bhangīs, and Doms, scavengers; the Dosādhs, village watchmen and messengers; the Goālās or Golās, milkmen; the Kaibarttas and Kewats, fishermen and cultivators; the Kāyasths, writers; the Koiri and Kāchhī, market gardeners; the Kumhārs, potters; the Pods, fishermen; and the Teli and Tili, oil-pressers and traders in oil. But the proportion of a caste that actually follows the traditional occupation may vary greatly. It is shown in the *Bengal Census Report* of 1901 that 80 per cent. of the Ahīrs in Bihār are engaged in agriculture; that of the Lower Bengal Brāhmans only 17 per cent., and of the Bihār Brāhmans only 8 per cent.,

perform religious functions; that only 8 per cent. of the Chamārs in Bihār live by working in leather, the remainder being cultivators or general labourers; that two-thirds of the Kāyasths in Bengal are agriculturists; and that only 35 per cent. of the Telis follow their traditional profession. A remarkable instance of the formation of a caste on the basis of distinctive occupation is supplied by the Gārpagāri, or hail-averters, in the Marāthā Districts of the Central Provinces, village servants whose duty it is to control the elements and protect the crops from the destructive hail-storms which are frequent in that part of India. Changes of occupation in their turn, more especially among the lower castes, tend, as above mentioned, to bring about the formation of separate castes. The Sadgops of Bengal have, within recent times, taken to agriculture and broken away from the pastoral caste to which they originally belonged; the educated Kaibarttas and Pods are in course of separating themselves from their brethren who have not learnt English; the Madhu-nāpit are barbers who became confectioners; the Chāsā-dhobās are washermen who took to agriculture.

(iii) Sectarian castes.

(iii) *The sectarian type* comprises a small number of castes which commenced life as religious sects founded by philanthropic enthusiasts who, having evolved some metaphysical formula offering a speedier release from the *taedium vitae* which oppresses the East, had further persuaded themselves that all men were equal, or at any rate that all believers in their teaching ought to be so. As time went on, the practical difficulties of realizing this ideal forced themselves upon the members of the sect; they found their company becoming unduly mixed; and they proceeded to reorganize themselves on the lines of an ordinary caste. A notable instance of this tendency to revert to the normal type of Hindu society is to be found in the present condition of the Lingāyat or Vīra Saiva caste of Bombay and Southern India, which numbers 2,600,000 adherents. Founded as a sect in the twelfth century, by a reformer who proclaimed the equality of all who received the eightfold sacrament ordained by him, and wore on their persons the mystic *phallus* emblematic of the god Siva, the Lingāyat community had begun, by the close of the seventeenth century, to develop endogamous sub-castes based upon the social distinctions which their founder had expressly abjured. At the last Census the process of transforming the sect into a caste had advanced still farther. In a petition presented to the Government of India the members of the Lingāyat

community protested against the 'most offensive and mischievous order' that all of them should be entered in the census papers as belonging to the same caste, and asked that they might be recorded as Vīra Saiva Brāhmans, Kshattriyas, Vaisyas, or Sūdras, as the case might be. It would be difficult to find a better illustration of the essentially particularist instinct of the Indian people, of the aversion with which they regard the doctrine that all men are equal, and of the attraction exercised by the aristocratic scheme of society which their ancient traditions enshrine. The legend of the four original castes may have no historical foundation, but there can be no question as to the spread of its influence or the strength of the sentiment which it still inspires. So long, in short, as the sectarian instinct confines itself to expressing a mere predilection for one god rather than another, or simply develops a new cult, however fantastic, which permits men to indulge in the luxury of religious eccentricity without quitting the narrow circle of their social environment, its operations are undisturbed and the sects which it forms may flourish and endure. But directly it invades the social sphere and seeks to unify and amalgamate groups of theoretically different origin, it comes in contact with a force too strong for it and has to give way.

(iv) Castes formed by crossing.

(iv) *Castes formed by crossing.*—Modern criticism has been especially active in its attacks on that portion of the traditional theory which derives the multitude of mixed or inferior castes from an intricate series of crosses between members of the original four. No one can examine the long lists which purport to illustrate the working of this process without being struck by much that is absurd and inconsistent. But in India it does not necessarily follow that, because the individual applications of a principle are ridiculous, the principle itself must have no foundation in fact. The last thing that would occur to the literary theorists of those times, or to their successors the pandits of to-day, would be to go back upon actual facts, and to seek by analysis and comparison to work out the true stages of evolution. They found the *a priori* method simpler and more congenial. Having once got hold of a formula, they insisted, like Thales and his contemporaries, on making it account for the entire order of things. Thus castes which were compact tribes, castes which had been developed out of trade corporations, and castes which expressed the distinction between fishing and hunting, agriculture and handicrafts, were all supposed to have been evolved by

interbreeding. But the initial principle, though it could not be stretched to explain everything, nevertheless enshrines a grain of historical fact. It happens that we can still observe its workings among a number of Dravidian tribes which, though not yet drawn into the vortex of Brāhmanism, have been in some degree affected by the example of Hindu organization. As regards inter-tribal marriages, these seem to be in a stage of development through which the Hindus themselves have passed. A man may marry a woman of another tribe; but the offspring of such unions do not become members of either the paternal or maternal groups, but belong to a distinct endogamous aggregate, the name of which often denotes the precise cross by which it was started. Among the large tribe of Mundās we find, for instance, nine such groups, whose names denote descent from intermarriages between Mundā men and women of other tribes. Illustrations of this sort might be multiplied almost indefinitely. The point to be observed is that the sub-tribes formed by inter-tribal crossing are from an early stage complete endogamous units, and that they tend continually to sever their slender connexion with the parent group and to stand forth as independent tribes.

Within the limits of the regular caste system, Mr. Gait (*Bengal Census Report*, 1901) mentions the Shāgirdpeshas of Bengal as a true caste 'which takes its origin from miscegenation, and which is still adding to its numbers in the same way. Amongst the members of the higher castes of Orissa who do not allow widow remarriage, and also amongst the Kāyasth immigrants from Bengal, it is a common practice to take as maid-servants and concubines women belonging to the lower clean castes, such as Chāsa and Bhandāri. The offspring of these maid-servants are known as Shāgirdpesha (servants). They form a regular caste of the usual type, and are divided into endogamous groups with reference to the caste of the male parent. . . . The caste of the mother makes no difference in the rank of the children, but those who can count several generations from their original progenitor rank higher than those in whose case the stigma of illegitimacy is more recent. . . . The relationship between the legitimate children of a man of good caste and their bastard brothers and sisters is recognized, but the latter cannot eat with the former.' In spite of its number (about 47,000), this caste is said to be of quite recent origin, and it is asserted that it did not exist a century and a half ago. An older and more instructive illustration, dating possibly from long before the

Christian era, of the formation of a caste by crossing, is furnished by the Khas of Nepāl, who appear to be the offspring of mixed marriages between Rājput or Brāhman immigrants and the Mongolian women of the country.

(v) National castes.

(v) *Castes of the national type.*—Where there is neither nation nor national sentiment, it may seem paradoxical to talk about a national type of caste. There exist, however, certain groups, usually regarded as castes at the present day, which cherish traditions of bygone sovereignty, and seem to preserve traces of an organization considerably more elaborate than that of an ordinary tribe. The Newārs, a mixed people of Mongoloid origin, who were the predominant race in Nepāl proper until the country was conquered and annexed by the Gurkha Prithwī Nārāyan in 1769, may be taken as an illustration of such a survival. The group comprises both Hindus and Buddhists. The two communities are quite distinct and each is divided into an elaborate series of castes.

If the Marāthās can be described as a caste, their history and traditions certainly stamp them as a caste of the national type. They numbered five million at the 1901 Census: 3,650,000 in Bombay, 1,100,000 in Hyderābād, 81,000 in Madras, 53,000 in Mysore, 61,000 in the Central Provinces and Berār, and 34,000 in Central India. According to Mr. Enthoven (*Bombay Census Report*, 1901), the Bombay Marāthās 'may be classified as a tribe with two divisions, Marāthā and Marāthā Kunbī, of which the former are hypergamous to the latter, but were not originally distinct. It remains to be explained that the Kunbīs also consist of two divisions: Desh Kunbīs, numbering 1,900,000, and Konkani Kunbīs, of whom there are 350,000 recorded. Intermarriage between these divisions is not usual. The barrier, however, seems to be purely geographical. It may not withstand the altered conditions due to improvements in communications, and it is not apparently based on any religious prohibition of intermarriages.' The highest class of Marāthās is supposed to consist of ninety-six families, who profess to be of Rājput descent and to represent the Kshattriyas of the traditional system. They wear the sacred thread, marry their daughters before puberty, and forbid widows to marry again. But their claim to kinship with the Rājputs is effectually refuted by the anthropometric data now published, and by the survival among them of *kuldevaks* or totems, such as the sunflower, the *kadamba* tree, the mango, the conch-shell, the peacock's feather, and turmeric, which are worshipped at marriages and at the cere-

mony of dedicating a new house, while their close connexion with the Kunbīs is attested by the fact that they take Kunbī girls as wives, though they do not give their own daughters to Kunbī men. A wealthy Kunbī, however, occasionally gains promotion to the higher grade and claims brevet rank as a Kshattriya. The fact seems to be that these superior families represent Kunbīs who came to the front under Muhammadan rule, or during the decline of the Mughal Empire won for themselves offices or estates, claimed the rank of landed gentry, and asserted their dignity by refusing their daughters to their less distinguished brethren.

(vi) Castes formed by migration

(vi) *Castes formed by migration.*—If members of a caste leave their original habitat and settle permanently in another part of India, they tend to develop into a distinct caste. The stages of the process are readily traced. In the first instance it is assumed that people who live in foreign parts must of necessity eat forbidden food, worship alien gods, and enter into relations with strange women. Consequently when they wish to take wives from among their own people, they find that their social status has been lowered and that they must pay for the privilege of marrying within the parent group. This luxury grows more and more expensive, and in course of time the emigrants marry only among themselves and thus become a sub-caste, usually distinguished by a territorial name, such as Jaunpuriā, Tirhutiā, Bārendra, and the like.

A good illustration of the formation of a caste by migration is to be found in the traditions of the Nambūdri or Nampūtiri Brāhmans of Malabar. These Brāhmans claim to have come to the west coast from various sacred localities in Kāthiāwār and the Northern Deccan. Mr. F. Fawcett describes them as 'the truest Aryans in Southern India,' and their complexion and features seem to lend some support to the tradition which assigns to them a foreign origin. Whatever their original stock may have been, they are now an entirely separate caste, differing from the Brāhmans of most other parts of India by their tendency to polygamy; by their rejection of infant marriage; by their restriction of marriage to the eldest son, the other brothers entering into relations with Nāyar women; and by the curious custom of ceremonial fishing which forms part of the marriage ritual with a certain division of them. Another instance of the same process is furnished by the Rārhi Brāhmans of Bengal. The current legend is that early in the eleventh century A.D., Rājā Adisura or Adisvara, finding the Brāhmans then settled in Bengal too ignorant to perform for

him certain Vedic ceremonies, applied to the Rājā of Kanauj for priests conversant with the sacred ritual of the Aryans. In answer to his request there were sent to him five Brāhmans of Kanauj, who brought with them their wives, their sacred fire, and their sacrificial implements, and from these the Rārhi Brāhmans are descended. Adisura did what the Rājās of outlying and unorthodox tracts of country (such as Bengal was in the eleventh century) have constantly done since and are doing still. A local chief, far removed from the great centres of Brāhmanical lore, somehow becomes aware of his ceremonial shortcomings. He sends for Brāhmans, gives them grants of land near his own residence, and proceeds at their dictation to reform his ways on the model of the devout kings whom Brāhmanical literature holds up as the ideal for a Rājā to follow. The Brāhmans find for him a pedigree of respectable antiquity and provide him with a family legend; and in course of time, by dint of money and diplomacy, he succeeds in getting himself recognized as a member of the local Rājput community. But that does not mean that the real Rājputs will acknowledge his pretensions; nor will the Brāhmans who have attached themselves to his fortunes retain their status among the community from which they have broken off. It will be said of them, as is said of the Brāhman immigrants into Bengal, that they have married local women, eaten forbidden food, adopted strange customs, and forgotten the endless details of the elaborate ritual which they set forth to teach. As priests *in partibus infidelium* they will be regarded with suspicion by the Brāhmans of their original stock: they will have to pay high for brides from among their own people, and eventually will be cut off altogether from the *ius connubii*. When that stage has been reached they will have become to all intents and purposes a separate caste, retaining the generic name of Brāhman, but forming a new species and presenting a distinctive type. And this great change will have been brought about by the simple fact of their abandoning the habitat of their original community.

Occasionally it may happen that social promotion, rather than degradation, results from a change of residence. In Chānda, a remote District of the Central Provinces, a number of persons returned themselves at the 1901 Census as Barwaiks, and it was stated that the Barwaiks were a clan of Rājputs from Orissa who had come to Nāgpur in the train of the Bhonsla Rājās and had taken military service under them. Now in Chotā Nāgpur the Baraiks or Chick-Baraiks are a sub-

caste of the Pāns, the helot weavers and basketmakers who perform a variety of service functions for the organized Dravidian tribes, and used to live in a kind of ghetto in the villages of the Khonds, for whom they purveyed children destined for human sacrifice. The Census Superintendent observes that 'though it is possible that the coincidence may be accidental, still there seems good reason to fear that it is from these humble beginnings that the Barwaik sept of Rājputs in Chānda must trace its extraction. And it is clear that, before the days of railways and the half-anna post, an imposture of this sort must have been practically impossible of detection.'

(vii) *Castes formed by changes of custom.*—The formation of new castes as a consequence of neglect of established usage, or the adoption of new ceremonial practices or secular occupations, has been a familiar incident of the caste system from the earliest times. We are told in Manu how men of the three twice-born castes who have not received the sacrament of initiation at the proper time, or who follow forbidden occupations, become Vrātyas or outcasts, intercourse with whom is punished with a double fine, and whose descendants are graded as distinct castes. Living as a Vrātya is a condition involving of itself exclusion from the original caste, and a Brāhman who performs sacrifices for such persons has to do penance. The idea of such changes of status is inherent in the system, and illustrations of its application are plentiful. Sometimes it figures in the traditions of a caste under the form of a claim to a more distinguished origin than is admitted by current opinion. The Skānda Purāna, for example, recounts an episode in Parasu Rāma's raid upon the Kshattriyas, the object of which is to show that the Kāyasths are by birth Kshattriyas of full blood, who by reason of their observing the ceremonies of the Sūdras are called Vrātya or incomplete Kshattriyas. The Bābhans or Bhuinhārs of the United Provinces and Bihār are supposed, according to some legends, to be Brāhmans who lost status by taking to agriculture. At the present day the most potent influence in bringing about elevations or depressions of social status, which may result ultimately in the formation of new castes, is the practice of widow remarriage. With the advance of orthodox ideas that may plausibly be ascribed to the extension of railways and the diffusion of primary education, it dawns upon some members of a particular caste that the custom of marrying widows is highly reprehensible, and, with the assistance of their Brāhmans, they set to work to discourage it. The first step is

(vii) Castes formed by changes of custom.

to abstain from intermarriage with people who practise the forbidden thing, and thus to form a sub-caste which adopts a high-sounding name derived from some famous locality like Ajodhyā or Kanauj, or describes itself as *Biyāhut* or *Behuta* (the married ones) by way of emphasizing the orthodox character of their matrimonial arrangements. Thus the Awadhiā or Ayodhiā Kurmīs of Bihār, and the Kanaujiā Kurmīs of the United Provinces, pride themselves on prohibiting the remarriage of widows, and are endeavouring to establish a shadowy title to be recognized as some variety of Kshattriya, in pursuance of which, with singular ignorance of the humble origin of the great Marāthā houses, they claim kinship with Sivajī, Sindhia, and the Bhonsla family of Nāgpur. In Bihār they have succeeded in attaining a higher rank than ordinary Kurmīs. But although the Awadhiās have achieved complete practical separation from the main body of Kurmīs, no one accepts them as Kshattriyas or Rājputs, nor are they recognized by Hindu public opinion as forming a distinct caste. In the Punjab the distinction between the Jāts and the Rājputs, both presumably sprung from a common Indo-Aryan stock, is marked by the fact that the former practise, and the latter always abstain from, widow remarriage. The same test applies in the Kāngra Hills, the most exclusively Hindu portion of the Punjab, where Musalmān domination was never fully established. Here the line between the Thakkar and Rāthi castes, both belonging to the lower classes of hill Rājputs, is said to consist in the fact that Rāthis do, and Thakkars do not, ordinarily practise widow marriage. In Southern India movements of the same sort may be observed. Among the begging castes which form nearly 1 per cent. of the population of the Tamil country, the Pandārams rank highest, in virtue of their abstention from meat and alcohol, and more especially of their prohibition of widow marriage.

Totemism. An account will be found in chapter ix of the *Report on the Census of India*, 1901, of what may be called the internal structure of tribes and castes in India—the various endogamous, exogamous, and hypergamous divisions which restrict and regulate matrimony, and form the minor wheels of the vast and intricate machinery by which Hindu society is controlled. It would be tedious to enter here upon a detailed description and analysis of these divisions. But from the point of view of general ethnology considerable interest attaches to one particular kind of division, to those exogamous groups which are based upon totems. The existence of totemism in India on a large scale

has been brought to notice only in recent years; the inquiries instituted in connexion with the Census have added materially to our knowledge of the subject; and special attention is being given to it in the Ethnographic Survey now being conducted in all British Provinces and the more important Native States. At the bottom of the social system, as understood by the average Hindu, we find, mainly in the Dravidian regions of India, a large body of tribes and castes each of which is broken up into a number of totemistic septs. Each sept bears the name of an animal, a tree, a plant, or of some material object, natural or artificial, which the members of that sept are prohibited from tilling, eating, cutting, burning, carrying, using, &c.; and the members of such a sept may not intermarry. In short, totemistic exogamy prevails in India on a fairly large scale and is still in active operation.

Classification of caste.

In a country where the accident of birth determines irrevocably the whole course of a man's social and domestic relations, and he must throughout life eat, drink, dress, marry, and give in marriage in accordance with the usages of the community into which he was born, one is tempted at first sight to assume that the one thing that he may be expected to know with certainty, and to disclose without much reluctance, is the name of the caste, tribe, or nationality to which he belongs. As a matter of fact, no column in the Census schedule displays a more bewildering variety of entries, or gives so much trouble to the enumerating and testing staff and to the central offices which compile the results. If the person enumerated gives the name of a well-known tribe, such as Bhīl or Santāl, or of a standard caste like Brāhman or Kāyasth, all is well. But he may belong to an obscure caste from the other end of India; he may give the name of a sect, of a sub-caste, of an exogamous sept or section, of a hypergamous group; he may mention some titular designation which sounds finer than the name of his caste; he may describe himself by his occupation, or by the Province or tract of country from which he comes. These various alternatives, which are far from exhausting the possibilities of the situation, undergo a series of transformations at the hands of the more or less illiterate enumerator who writes them down in his own vernacular, and the abstractor in the central office who transliterates them into English. Then begins a laborious and most difficult process of sorting, referencing, cross-referencing, and corresponding with local authorities, which ultimately results in the compilation of the Census Table XIII, showing the distribution of the inhabitants

of India by caste, tribe, race, or nationality. The arrangement of this table is alphabetical, and it consists of two parts. The first is a general list of all the groups returned, with their distribution by religion, while the second shows the distribution by Provinces and States of all groups with an aggregate strength of 10,000. An analysis of the 1901 table shows that it includes 2,378 main castes and tribes, and forty-three races or nationalities. With the latter we are not concerned here; as to the former, the question at once arises—on what principle should they be arranged? An alphabetical system is useful for reference, and essential for the purely statistical purposes of a census table. But it does not help in the least towards presenting an intelligible picture of the social grouping of that large proportion of the people of India which is organized, admittedly or tacitly, on the basis of caste.

Principles adopted in the 1901 Census.

Accordingly, the principle adopted in 1901 was that of classification by social precedence, as recognized by native public opinion at the present day, and manifesting itself in the facts that particular castes are supposed to be the modern representatives of one or other of the castes of the theoretical Hindu system; that Brāhmans will take water from certain castes; that Brāhmans of high standing will serve particular castes; that certain castes, though not served by the best Brāhmans, have nevertheless got Brāhmans of their own, whose rank varies according to circumstances; that certain castes are not served by Brāhmans at all, but have their own priests; that the status of certain castes has been raised by their taking to infant marriage or abandoning the remarriage of widows; that the status of some castes has been lowered by living in a particular locality; that the status of others has been modified by their pursuing some occupation in a special or peculiar way; that some can claim the services of the village barber, the village palanquin-bearer, the village midwife, &c., while others cannot; that some castes may not enter the court-yards of certain temples; that some are subject to special taboos, such as that they must not use the village well, or may draw water only with their own vessels, that they must live outside the village or in a separate quarter, that they must leave the road on the approach of a high-caste man or must call out to give warning of their approach. In the case of the Animistic tribes it was mentioned that the prevalence of totemism and the degree of adoption of Hindu usages would serve as ready tests. Most of the Provincial Census Superintendents readily grasped the main idea of the scheme, and

their patient industry, supplemented by the intelligent assistance given by the highest native authorities, has added very greatly to our knowledge of an obscure and intricate subject.

General results.

As no stereotyped scheme of classification was drawn up, but every Province was left to adopt its own system in consultation with local experts and representative men, it is clearly impossible to draw up any general scheme for the whole of India. One might as well try to construct a table of social precedence for Europe which should bring together Spanish grandees, Swiss hotel-keepers, Turkish Pashas, and Stock Exchange millionaires, and should indicate the precise degree of relative distinction attaching to each. The problem in fact is essentially a local one, and India is no more one country than is Europe. The Provincial schemes of classification are summarized in the Appendix to chapter xi of the *Report on the Census of India*, 1901. Although they cannot be reduced to common terms, they exhibit points of resemblance and difference which deserve some further examination. The first point to observe is the predominance throughout India of the influence of the traditional system of four original castes. In every scheme of grouping the Brāhman heads the list. Then come the castes whom popular opinion accepts as the modern representatives of the Kshattriyas, and these are followed by the mercantile groups supposed to be akin to the Vaisyas. When we leave the higher circles of the twice-born, the difficulty of finding a uniform basis of classification becomes apparent. The ancient designation 'Sūdra' finds no great favour in modern times, and we can point to no group that is generally recognized as representing it. The term is used in Bombay, Madras, and Bengal to denote a considerable number of castes of moderate respectability, the higher of whom are considered 'clean' Sūdras, while the precise status of the lower is a question which lends itself to controversy. At this stage of the grouping a sharp distinction may be noticed between Northern India and Bombay and Madras. In Rājputāna, the Punjab, the United Provinces, the Central Provinces, Bengal, and Assam, the grade next below twice-born rank is occupied by a number of castes from whose hands Brāhmans and members of the higher castes will take water and certain kinds of sweetmeats. Below these again is a rather indeterminate group from whom water is taken by some of the higher castes, but not by others. Farther down, where the test of water no longer applies, the status of a caste depends on the nature of its occupation and its habits in respect of diet. There are castes whose touch defiles the

twice-born, but who do not commit the crowning enormity of eating beef; while below these again in the social system of Northern India are people like Chamārs and Doms, who eat beef and various sorts of miscellaneous vermin. In Western and Southern India the idea that the social status of a caste depends on whether Brāhmans will take water and sweetmeats from its members is unknown, for the higher caste will as a rule take water only from persons of their own caste and sub-caste. In Southern India the idea of ceremonial pollution by the proximity of a member of an unclean caste has been developed with much elaboration. Thus, the table of social precedence attached to the Cochin Report shows that, while a Nāyar can pollute a man of a higher caste only by touching him, people of the Kammālan group, including masons, black-smiths, carpenters, and workers in leather, pollute at a distance of 24 feet, toddy-drawers (Iluvan or Tīyan) at 36 feet, Pulayan or Cheruman cultivators at 48 feet; while in the case of the Paraiyan (Pariah), who eats beef, the range of pollution is stated to be no less than 64 feet.

The subject is examined fully in some of the Provincial Census Reports of 1901, to which the reader is referred for further particulars. No attempt was made to grade every caste. Large classes were formed, and the various groups included in these were arranged in alphabetical order so as to escape the necessity of settling the more delicate questions of precedence. As an illustration of the method of procedure, we may refer to the table of precedence for Bengal proper, which was compiled by Mr. Risley some years ago, and was adopted by Mr. Gait (Census Superintendent, 1901) after careful examination by local committees of native gentlemen appointed for the purpose.

The seven main classes of Hindus in Bengal.

The entire Hindu population of this tract, numbering nineteen millions, has been divided into seven classes. The first class is reserved for the Brāhmans, of whom there are more than a million, forming 6 per cent. of the Hindus of Bengal. As every one knows, there are Brāhmans and Brāh-mans, of status varying from the Rārhi, who claim to have been imported by Adisura from Kanauj, to the Barna Brāh-mans who serve the lower castes, from whose hands pure Brāhmans will not take water, and to the Vyāsokta Brāhmans who serve the Chāsi Kaibartta caste, and rank so low that even their own clients will not touch food in their houses.

Next in order, at the top of the second class, come the Rājputs, basing their claims to precedence on their supposed

descent from the pure Rājputs of the distant Indo-Aryan tract. Their number (113,405) must include a large proportion of families belonging to local castes who acquired land and assumed the title of Rājput on the strength of their territorial position. Then follow the Baidyas, by tradition physicians, and the writer caste of Kāyasths. The former pose as the modern representatives of the Ambastha of Manu, and assert their superiority to the Kāyasths. The Kāyasths, on the other hand, claim to be Kshattriyas who took to clerical work; deny the identity of the Baidyas with the Ambasthas; and describe them as a local caste, unknown in the great centres of Hinduism, who were Sūdras till about a century ago, when they took to wearing the sacred thread and bribed the Brāhmans to acquiesce in their pretensions.

The third class, numbering three millions, comprises the functional castes originally known as Navasākha (the nine 'branches' or 'arrows') and the other 'clean' Sūdras, from whose hands the higher castes take water, and who are served by high-class Brāhmans. Confectioners, perfume vendors, betel growers, oilmen, gardeners, potters, and barbers figure in this group, the constitution of which appears to have been largely determined by considerations of practical convenience. The preparation of a Hindu meal is a very elaborate performance, involving lengthy ablutions and a variety of ritualistic observances which cannot be performed on a journey; and it is essential to the comfort of the orthodox traveller that he should be able to procure sweetmeats of various kinds without being troubled by misgivings as to the ceremonial cleanliness of the people from whom he buys them. In matters of food and drink caste rules are wisely elastic. It has been held that neither ice nor soda-water counts as water for the purpose of conveying pollution; there are special exemptions in favour of biscuits and patent medicines, for the last of which the Bengali has an insatiable appetite; and in an outlying District where the only palanquin-bearers available were Dravidian Bhuiyās, these have been promoted to the rank of a water-giving (*jalācharaniya*) caste in order that the twice-born traveller might be able to get a drink without quitting his palanquin.

The fourth class includes only two castes—the Chāsi Kaibartta and the Goālā—from whom water is taken by the high castes, but whose Brāhmans are held to be degraded. About the former group Mr. Risley wrote in 1891[1]: 'It seems likely, as time goes on, that this sub-caste will rise in

[1] *Tribes and Castes of Bengal.*

social estimation, and will altogether sink the Kaibartta, so that eventually it is possible that they may succeed in securing a place with the Navasākha.' The forecast has so far been fulfilled that, at the 1901 Census, the Chāsi Kaibartta called themselves Māhisya, the name of the offspring of a legendary cross between Kshattriyas and Vaisyas, and posed as a separate caste.

Class V contains a rather miscellaneous assortment of castes, including the Baishtam, the Sunri, and the Subarnabanik, from whom the higher castes do not usually take water. Their precedence is also defined by the fact that, although the village barber will shave them, he will not cut their toe-nails, nor will he take part in their marriage ceremonies.

The sixth class includes a long list of castes, numbering nearly eight millions, who abstain from eating beef, pork, and fowls, but from whom the higher castes will not take water. They are served by degraded Brāhmans, the regular barbers refuse to shave them, and some of them have special barbers of their own. Most of them, however, can get their clothes washed by the village washerman. The typical members of this group are the Bāgdi (1,032,004), Dravidian cultivators and labourers; the Jeliya or fishing Kaibartta (447,237); the Namasūdra or Chandāl (1,860,914); the Pod (464,921), fishermen and cultivators; and the Rājbansi-Koch (2,065,982), nearly all of whom are small cultivators.

Class VII represents the lowest grade of the Bengal system, castes who eat all manner of unclean food, whose touch pollutes, whom no Brāhman, however degraded, will serve, and for whom neither barber nor washerman will work. It comprises the scavenging Doms and Haris; the leather-working Chamārs and Muchis; and the Bauris, who eat rats and revere the dog as their totem, because, as some of them told Colonel Dalton, it is the right thing to have some sacred animal, and dogs are useful while alive and not very nice to eat when dead.

Caste tendencies among Muhammadans.

Islām, whether regarded as a religious system or as a theory of things, is in every respect the antithesis of Hinduism. Its idea is strenuous action rather than hypnotic contemplation; it allots to man a single life and bids him make the best of it; its practical spirit knows nothing of a series of transmigrations, of *karma*, of the weariness of existence which weighs upon the Hindu mind. For the dream of absorption into an impersonal *Weltgeist* it substitutes a very personal Paradise, made up of joys such as all Orientals understand. On its social side the

religion of Muhammad is equally opposed to the Hindu scheme of a hierarchy of castes, an elaborate stratification of society based upon subtle distinctions of food, drink, dress, marriage, and ceremonial usage. In the sight of God and of His Prophet all followers of Islām are equal. In India, however, caste is in the air; its contagion has spread even to the Muhammadans; and we find its evolution proceeding on characteristically Hindu lines. In both communities foreign descent forms the highest claim to social distinction; in both promotion cometh from the west. As the twice-born Aryan is to the mass of Hindus, so is the Muhammadan of alleged Arab, Persian, Afghān, or Mughal origin to the rank and file of his co-religionists. And just as in the traditional Hindu system men of the higher groups could marry women of the lower, while the converse process was vigorously condemned, so, within the higher ranks of the Muhammadans, a Saiyid will marry a Sheikh's daughter but will not give his daughter in return; and intermarriage between the upper circle of *soi-disant* foreigners and the main body of Indian Muhammadans is generally reprobated, except in parts of the country where the aristocratic element is small and must arrange its marriages as best it can. Even there, however, it is only under the stress of great poverty that a member of the *ashrāf*, or 'noble' class, will give his daughter to one of the *ajlāf*, or 'low people,' as converts of indigenous origin are called in Bengal. Of course, the limits of the various groups are not defined as sharply as they are with the Hindus. The well-known proverb which occurs in various forms in different parts of Northern India—'Last year I was a Jolāhā (weaver); now I am a Sheikh; next year if prices rise, I shall become a Saiyid'—marks the difference, though analogous changes of status are not unknown among Hindus and, as Mr. Gait observes, 'promotion is not so rapid in reality as it is in the proverb.' But speaking generally, it may be said that the social cadre of the higher ranks of Muhammadans is based on hypergamy with a tendency in the direction of endogamy, while the lower functional groups are strictly endogamous, and are organized on the model of regular castes, with councils and officers which enforce the observance of caste rules by the time-honoured sanction of boycotting.

Absence of caste system in Baluchistān and Burma.

On the outskirts of the Empire lie two regions where Hindu standards of social precedence and Hindu notions of caste are neither recognized nor known. In Baluchistān, until less than a generation ago, Hindus were tolerated only as a useful class of menials who carried on the petty trade which the fighting

races deemed below their dignity. They adopted the device, not unknown in mediaeval Europe, of putting themselves under the protection of their more powerful neighbours, and Mr. Hughes-Buller (*Baluchistān Census Report*, 1901) tells us that even now a Hindu, when asked to what caste he belongs, 'will often describe himself by the name of the tribal group to which he holds himself attached.' Among the non-Hindu people of Baluchistān the question of social precedence is intricate and obscure, and its details must be studied in Mr. Hughes-Buller's excellent Report. Of the three chief races, the Afghāns rank highest, in virtue of their former sovereignty; then come the Baloch, who also once bore rule; and last the Brāhui, who were in power at the time of the British occupation. The relative position of the two latter is indicated by various proverbs, by the attempts of the Brāhui to trace their descent to the Baloch, and by the fact that 'no self-respecting Baloch will give his daughter to a Brāhui.' Below these races come the Jats, a term which seems to be loosely used to denote all sorts of menial classes, including professional musicians (Lāngahs), blacksmiths (Loris), and leather-workers (Muchis). But even here there is no hard and fast prohibition of intermarriage, and both Baloch and Brāhui will take wives from among the Jats. Within the circle of each tribe a condition of theoretical equality appears to prevail, tempered by personal considerations arising from capacity to lead, religious sanctity, age, and kinship with a ruling family.

In Burma caste is so little known that the Burmese language possesses no word for it, while one of the difficulties of conducting the census of the numerous Indian immigrants was the impossibility of making the average Burman enumerator understand the meaning of the Indian term *zāt* or *jāt*. Differences of religion he can grasp in a vague sort of way; he has a notion of what is meant by race; but caste remains to him an insoluble mystery, a thing with which his democratic spirit has no sympathy whatever. Mr. Lowis (*Burma Census Report*, 1901) assures us that there are not and never have been any true castes in Burma, though a class of landed proprietors in Minbu, known as the Thugaungs, appear to be endogamous, and thirty-six professional groups with hereditary occupations are said to have existed among the Chins.

Distribution of social groups.

No attempt can be made here to analyse and explain the distribution of the nearly 2,400 castes and tribes which have been enumerated in the 1901 Census. The distribution of thirty-six of the principal tribes and castes is shown in the series

of maps annexed to chapter xi of the *Census Report*, and a glance at these will show that some castes are diffused over the whole of India, while others are localized in particular Provinces or tracts of country[1]. The typical instance of a widely diffused caste is furnished by the Brāhmans, who number nearly fifteen millions, and represent a proportion of the total population ranging from ten per cent. in the United Provinces, Central India, and Rājputāna, to three per cent. in Madras, the Central Provinces, and Bengal proper, and two per cent. in Assam and Chotā Nāgpur. The distribution accords fairly well with the history and traditions of the caste. They are strongest in their original centre, numbering nearly five millions in the United Provinces, and weakest in the outlying tracts, peopled mainly by non-Aryan races, whom their influence has even now only imperfectly reached. There can, moreover, be little doubt that many of the Brāhmans of the more remote tracts have been manufactured on the spot by the simple process of conferring the title of Brāhman on the tribal priests of the local deities. The so-called Barna Brāhmans, who serve the lower castes of Bengal, probably obtained sacerdotal rank in this fashion. That the priestly caste is not of altogether unmixed descent is attested by the numerous legends of Rājās who, having sworn a rash oath to feed a stated number of Brāhmans, found the supply run short and were obliged to make them up for the occasion out of any materials that were at hand. As with the Brāhmans, so in the chief functional groups the tendency is towards wide diffusion, and their racial composition probably differs materially in different Provinces. Owing to differences of language, the maps above mentioned fail to bring out the complete facts in relation to the whole of India. Thus, the leather-workers (Chamār and Muchi) of Northern India, numbering about twelve millions and forming twelve per cent. of the population of the United Provinces, correspond with the Chakkiliyan (486,884) and Mādiga (755,316) of Madras, but the maps do not include these. In each Province such groups form, of course, distinct castes which have probably been evolved independently.

Of the localized groups a large number are admittedly tribes. The Bhīl, Gond, Kolī, and Santāl come within this category, and are still outside the Hindu social system. The Doms, Dosādhs, Gūjars, Jāts, Kaibarttas, Namasūdras (Chandāls), Pods, Nāyars, Pallis, Paraiyans (Pariahs), and Rājbansi-Koch

[1] The distribution of the most important castes is shown, more generally, in the ethnographic map of the Atlas accompanying the *Gazetteer*.

represent tribes which have been transformed into castes at a comparatively recent date and still retain some traces of the tribal stage of development.

Origin of caste. The Indian theory.

Several theories of the origin of caste are to be found in the literature of the subject. The oldest and most famous is accepted as an article of faith by all orthodox Hindus, and its attraction extends, as each successive Census shows, through an ever-widening circle of aspirants to social distinction. It appears in its most elaborate form in the curious jumble of magic, religion, law, custom, ritual, and metaphysics which is commonly called the Institutes of Manu. Here we read how the *Anima Mundi*, the supreme soul which 'contains all created beings and is inconceivable,' produced by a thought a golden egg, in which 'he himself was born as Brahmā, the progenitor of the whole world.' Then 'for the sake of the prosperity of the worlds, he caused the Brāhman, the Kshattriya, the Vaisya, and the Sūdra to proceed from his mouth, his arms, his thighs, and his feet,' and allotted to each of these their distinctive duties. The Brāhman was enjoined to study, teach, sacrifice, and receive alms; the Kshattriya to protect the people and abstain from sensual pleasures; the Vaisya to tend cattle, to trade, to lend money, and to cultivate land; while for the Sūdra was prescribed the comprehensive avocation of meekly serving the other three groups. Starting from this basis, the standard Indian tradition proceeds to trace the evolution of the caste system from a series of complicated crosses, first between members of the four groups and then between the descendants of these initial unions. The men of the three higher groups might marry women of any of the groups below them, and if the wife belonged to the group next in order of precedence the children took her rank, and no new caste was formed. If, however, the mother came from a group lower down in the scale, her children belonged neither to her group nor to their father's, but formed a distinct caste called by a different name. Thus the son of a Brāhman by a Vaisya woman is an Ambastha, to whom belongs the art of healing; while if the mother is a Sūdra, the son is a Nishāda and must live by killing fish. The son of a Kshattriya father and a Sūdra mother is 'a being called Ugra, resembling both a Kshattriya and a Sūdra, ferocious in his manners and delighting in cruelty.' In all of these the father is of higher rank than the mother, and the marriages are held to have taken place in the right order (*anuloma*, or 'with the hair'). Unions of the converse type, in which the woman belongs to a superior group, are condemned as *pratiloma*,

or 'against the hair.' The extreme instance of the fruit of *pratiloma* relations is the Chandāl, the son of a Brāhman woman by a Sūdra, who is described as 'that lowest of mortals,' and is condemned to live outside the village, to clothe himself in the garments of the dead, to eat from broken dishes, to execute criminals, and to carry out the corpses of friendless men. But the Ayogavas, with a Sūdra father and a Kshattriya mother, are not much better off, for the accident of their birth is sufficient to brand them as wicked people who eat reprehensible food. Alliances between the descendants of these first crosses produce, among others, the Sairandhra who is 'skilled in adorning his master,' and pursues as an alternative occupation the art of snaring animals; and 'the sweet-voiced Maitreyaka who, ringing a bell at the appearance of dawn, continually praises great men.' Finally, a fresh series of connubial complications is introduced by the Vrātya, the twice-born men who have neglected their sacred duties and have among their direct descendants the Malla, the Licchivi, the Nata, the Karana, the Khasa, and the Drāvida, while each of these in its turn gives rise to further mazes of hypothetical parentage.

Its historic elements.

It is small wonder that European critics should have been so impressed by the unreal character of this grotesque scheme of social evolution, that some of them have put it aside as a mere figment of the subjective intellect of the ingenious Brāhman. Yet, fantastic as it is, it opens indirectly and unconsciously an instructive glimpse of prehistoric society in India. It shows us that at the time when Manu's treatise was compiled, probably about the second century A.D., there must have existed an elaborate and highly developed social system, including tribal or national groups like the Nishāda, Māgadha, Vaideha, Malla, Licchivi, Khasa, Dravida, Saka, Kirāta, and Chandāl; and functional groups such as the Ambastha, who were physicians; the Sūta, who were concerned with horses and chariots; the Nishāda, and the Mārgavas, Dasas or Kaivartas, who were fishermen; the Ayogava, carpenters; the Kārāvara and Dhigvansa, workers in leather; and the Vena, musicians and players on the drum. It is equally clear that the occupations of Brāhmans were as diverse as they are at the present day, and that their position in this respect was just as far removed from that assigned to them by the traditional theory. In the list of Brāhmans whom a pious householder should not entertain at a *srāddha*[1] we find physi-

[1] *Laws of Manu*, iii. 149–167.

cians; sellers of meat; shopkeepers; usurers; actors; singers; oilmen; keepers of gambling houses; sellers of spices; makers of bows and arrows; cowherds, and trainers of elephants, oxen, horses or camels; astrologers; bird-fanciers; fencing-masters; architects; breeders of sporting dogs; falconers; cultivators; shepherds; and even carriers of dead bodies. The conclusions suggested by the passages cited from Manu are confirmed by Dr. Richard Fick's instructive study of the structure of society in Bihār and the Eastern Districts of the United Provinces at the time of Buddha[1]. Dr Fick's work is based mainly upon the Jātakas or 'birth-stories' of the Southern Buddhists; and from these essentially popular sources, free from any suggestion of Brāhmanical influence, he succeeds in showing that, at the period depicted, the social organization in the part of India with which his authorities were familiar did not differ very materially from that which prevails at the present day. Then, as now, the traditional hierarchy of four castes had no distinct and determinate existence, still less had the so-called mixed castes supposed to be derived from them, while of the Sūdras in particular no trace at all was to be found. Then, as now, Indian society was made up of a medley of diverse and heterogeneous groups, apparently not so strictly and uniformly endogamous as the castes of to-day, but containing within themselves the germs out of which the modern system has developed by natural and insensible stages. That development has been furthered by a variety of influences which will be discussed below.

Its probable origin.

Assuming that the writers of the law books had before their eyes the same kind of social chaos that exists now, the first question that occurs is, From what source did they derive the theory of the four castes? Manu, of course, as Sir Henry Maine has pointed out, is a relatively modern work; but the traditional scheme of castes figures in earlier law books, such as the Baudhāyana and Apastamba, and it seems probable that for them it was not so much a generalization from observed facts as a traditional theory, which they attempted to stretch so as to explain the facts. The Indian pandit does not take kindly to inductive methods, nor is it easy to see how he could have arrived by this road at a hypothesis which breaks down directly it is brought into contact with the realities of life. But it is possible that the Brāhmanical theory of castes may be nothing more than a modified version of the division of

[1] *Die sociale Gliederung im nordöstlichen Indien zu Buddha's Zeit* (1897).

society into four classes—priests, warriors, cultivators, and artisans—which appears in the sacerdotal literature of ancient Persia[1]. It is not suggested that the Irānian legend of four classes formed part of the stock of tradition which the Aryans brought with them into India. Had this been so, the myth relating to their origin would have figured prominently in the Vedas, and would not have appeared solely in the Purusha Sukta, which most critics agree in regarding as a modern interpolation. The conjecture is that the relatively modern compilers of the law books, having become acquainted with the Irānian legend, were fascinated by its assertion of priestly supremacy, and made use of it as the basis of the theory by which they attempted to explain the manifold complexities of the caste system. The procedure is characteristic of Brāhmanical literary methods, and is in itself no more absurd than a recent attempt on the part of the Aryā Samāj to discover in the Rig-veda an anticipation of the discoveries of modern science.

The Indian and Irānian classes.

The differences in the Indian and Irānian categories are trifling, and admit of being accounted for by the fact that India had, what Persia had not, a large aboriginal population, differing from the Indo-Aryans in respect of religion, usages, and physical type, and more especially in the conspicuous attribute of colour. These people had somehow to be brought within the limits of the scheme; and this was done by the simple process of lumping them together in the servile class of Sūdras, which is sharply distinguished from the twice-born groups and has a far lower status than is assigned to the artisans in the Irānian system. Thus the four *varnas*, or colours, of the Indian myth seem to occupy an intermediate position between the purely occupational classes of ancient Persia and Egypt and the rigidly defined castes of modern India. In the Persian system only the highest group of Athravans or priests was endogamous, while between the other three groups, as between all the groups of the Egyptian system (excluding the swineherds if we follow Herodotus), no restrictions on intermarriage appear to have been recognized. Moreover, as is implied by the distinction between the twice-born classes and the Sūdras, and by the prominence given to the element of colour (*varna*), the Indian system rests upon a basis of racial antagonism of which there is no trace in Persia and Egypt. Yet in the stage of development portrayed in the law books the system had not hardened

[1] Spiegel, *Eranische Alterthumskunde*, iii. 547-670.

into the rigid mechanism of the present day. It is still more or less fluid; it admits of intermarriage under the limitations imposed by the rule of hypergamy; it represents caste in the making, not caste as it has since been made. This process of caste-making has indeed by no means come to an end. Fresh castes are constantly being formed, and wherever we can trace the stages of their evolution they seem to proceed on the lines followed in the traditional scheme. The first stage is for a number of families, who discover in themselves some quality of social distinction, to refuse to give their women in marriage to other members of the caste, from whom nevertheless they continue to take wives. After a time, when their numbers have increased and they have bred women enough to supply material for a *ius connubii* of their own, they close their ranks, marry only among themselves, and pose as a superior sub-caste of the main caste to which they belong. Last of all they break off all connexion with the parent stock, assume a new name which ignores or disguises their original affinities, and claim general recognition as a distinct caste. The educated Pods of Bengal are an illustration of the first stage; the Chāsi Kaibartta of the second; the Māhisya of the third.

Sir Denzil Ibbetson's theory.

We may now pass from the pious fictions of Manu and the Rāmāyana to those modern critical theories which, whether they carry conviction or not, at least start from and give full weight to the facts, and make an honest attempt to work out a scientific solution of the problem. Among these Sir Denzil Ibbetson's description of caste in the Punjab[1] contains the most vivid presentment of the system in its everyday working, of the various elements which have contributed to its making, and of the surprising diversity of the results which have been produced. From this wealth of material it is not altogether easy to disentangle the outlines of a cut-and-dried theory, and it may well have been the intention of the writer to leave the question more or less open, and to refrain from the futile endeavour to compress such infinite variety within the limits of any formula. The following passage sums up the leading features of the hypothesis; but the exposition of its working requires to be studied as a whole, and the entire section dealing with the evolution of caste will be found in the Ethnographic Appendices to the *Report on the Census of India*, 1901.

'Thus, if my theory be correct, we have the following steps in the process by which caste has been evolved in the Punjab:—

[1] *Report on the Census of the Punjab*, 1881, pp. 172-341.

(1) the tribal divisions common to all primitive societies; (2) the guilds based upon hereditary occupation common to the middle life of all communities; (3) the exaltation of the priestly office to a degree unexampled in other countries; (4) the exaltation of the Levitical blood by a special insistence upon the necessarily hereditary nature of occupation; (5) the preservation and support of this principle by the elaboration from the theories of the Hindu creed or cosmogony of a purely artificial set of rules, regulating marriage and intermarriage, declaring certain occupations and foods to be impure and polluting, and prescribing the conditions and degree of social intercourse permitted between the several castes. Add to these the pride of social rank and the pride of blood which are natural to man, and which alone could reconcile a nation to restrictions at once irksome from a domestic and burdensome from a material point of view; and it is hardly to be wondered at that caste should have assumed the rigidity which distinguishes it in India.'

M. Senart's criticism on this theory[1] is directed to two points. He demurs, in the first place, to the share which he supposes it to assign to Brāhmanical influence, and challenges the supposition that a strict code of rules, exercising so absolute a dominion over the consciences of men, could be merely a modern invention, artificial in its character and self-regarding in its aims. Secondly, he takes exception to the disproportionate importance which he conceives Sir Denzil Ibbetson to attach to community of occupation, and points out that, if this were really the original binding principle of caste, the tendency towards incessant fission and dislocation would be much less marked: the force that in the beginning united the various scattered atoms would continue to hold them together to the end. Both criticisms appear to miss an essential feature in the scheme, the influence of the idea of kinship, which is certainly the oldest and probably the most enduring factor in the caste system, and which seems to have supplied the framework and the motive principle of the more modern restrictions based upon ceremonial usage and community of occupation.

Mr. Nesfield's theory.

Mr. Nesfield[2] is a theorist of quite a different type. He feels no doubts and is troubled by no misgivings. Inspired by the systematic philosophy of Comte, he maps out the whole confused region of Indian caste into a graduated series of

[1] *Les Castes dans l'Inde.*

[2] *Brief View of the Caste System of the North-Western Provinces and Oudh*, pp. 3, 4, 75, 88, 229-132.

groups and explains exactly how each has come by the place that it occupies in the scheme. As stated on page 286, he assumes as the basis of his theory the essential unity of the Indian race, and appeals to 'physiological resemblance' to prove that 'for the last three thousand years at least no real difference of blood between Aryan and aboriginal' has existed 'except perhaps in a few isolated tracts.' In his opinion the conquering Aryan race was completely absorbed by the indigenous population. The homogeneous people thus formed are divided by Mr. Nesfield, in the area to which his researches relate, the United Provinces of Agra and Oudh, into the following seven groups, among which he distributes the 121 castes enumerated in the Census of 1881:—

I. Casteless tribes.
II. Castes connected with land:
  A. Allied to hunting state.
  B. Allied to fishing state.
  C. Allied to pastoral state.
  D. Agricultural.
  E. Landlords and warriors.
III. Artisan castes:
  A. Preceding metallurgy.
  B. Coeval with metallurgy.
IV. Trading castes.
V. Serving castes.
VI. Priestly castes.
VII. Religious orders.

The classification, it will be observed, is based solely upon occupation, and it expresses Mr. Nesfield's conviction that 'function, and function only, as I think, was the foundation upon which the whole caste system of India was built up.' The order of the groups is determined by the principle that 'each caste or group of castes represents one or other of those progressive stages of culture which have marked the industrial development of mankind, not only in India, but in every other country in the world wherein some advance has been made from primeval savagery to the arts and industries of civilized life. The rank of any caste as high or low depends upon whether the industry represented by the caste belongs to an advanced or backward stage of culture; and thus the natural history of human industries affords the chief clue to the gradations as well as to the formation of Indian castes.' At the bottom of the scale are the more or less primitive tribes—Thārus, Kanjars, Doms, and Nats—'the last remains and sole surviving representatives of the aboriginal Indian savage, who was once the only inhabitant of the Indian continent, and from whose stock the entire caste system, from the sweeper to the priest, was fashioned by the slow growth of centuries.' Then come the hunting Baheliyas, the Mallāhs and Dhīmars (boatmen and fishermen), the pastoral Ahīrs and Gadariās, and the great mass of agriculturists, while above these he finds in the

Kshattriya or Rājput the sole representative of the landlord and warrior caste. The artisan castes are subdivided with reference to the supposed priority of the evolution of their crafts. The basket-making Bānsphors, the weavers (Kori and Jolāhā), the potters (Kumhārs), and the oilmen (Teli) fall within the more primitive group antecedent to metallurgy, while blacksmiths, goldsmiths, tailors, and confectioners are placed in the group coeval with the use of metals. Above them again come the trading and the serving castes, among whom we find in rather odd collocation the scavenging Bhangī, the barber (Nāpit or Nai), the bard and genealogist (Bhāt), and the Kāyasths, who are described as estate managers and writers. The Brāhmans and the religious orders complete the scheme. But the mere classification obviously offers no solution of the real problem. How did these groups, which occur in one form or another all over the world, become hardened into castes? Why is it that in India alone their members are absolutely forbidden to intermarry? Mr. Nesfield replies without hesitation that the whole series of matrimonial taboos which constitute the caste system are due to the initiative of the Brāhmans. According to him they introduced for their own purposes, and in order to secure the dignity and privileges of their own caste, the rule that a Brāhman could only marry a Brāhman, and all the other classes, who up to that time had intermarried freely, followed their example, 'partly in imitation and partly in self-defence.' The proposition recalls the short way that writers of the eighteenth century were apt to take with historical problems, reminding one of Bolingbroke's easy assertion that the sacred literature of Egypt was invented by the priests. Detailed criticism would be out of place here: the main object of this chapter is to lay stress on precisely those factors of evolution which Mr. Nesfield ignores; but it may be observed that a theory which includes in the same categories the Dom and the Teli, the Banjārā and the Khattrī, the Bhangī and the Kāyasth must, in the race for acceptance, have a good deal of leeway to make up.

M. Senart's theory.

After examining the views propounded by Sir Denzil Ibbetson and Mr. Nesfield, and by Mr. Risley in his *Tribes and Castes of Bengal*, M. Senart passes on to formulate his own theory of the origin of caste. In his view caste is the normal development of ancient Aryan institutions, which assumed this form in the struggle to adapt themselves to the conditions with which they came into contact in India. In developing this proposition he relies greatly upon the general parallelism that may be traced between the social organization of the Hindus

and that of the Greeks and Romans in the earlier stages of their national development. He points out the close correspondence that exists between the three series of groups—*gens*, *curia*, tribe at Rome; family, φρατρία, φυλή in Greece; and family, *gotra*, caste in India. Pursuing the subject into fuller detail, he seeks to show that the leading principles which underlie the caste system form part of a stock of usage and tradition common to all branches of the Aryan people. In the department of marriage, for example, the Athenian γένος and the Roman *gens* present striking resemblances to the Indian *gotra*. We learn from Plutarch that the Romans never married a woman of their own kin, and among the matrons who figure in classical literature none bears the same gentile name as her husband. Nor was endogamy unknown. At Athens, in the time of Demosthenes, membership of a φρατρία was confined to the offspring of the families belonging to the group. In Rome the long struggle of the plebeians to obtain the *ius connubii* with patrician women belongs to the same class of facts; and the patricians, according to M. Senart, were guarding the endogamous rights of their order—or should we not rather say the hypergamous rights? for in Rome, as in Athens, the primary duty of marrying a woman of equal rank did not exclude the possibility of union with women of humbler origin. We read in Manu how the gods disdain the oblations offered by a Sūdra: at Rome they were equally offended by the presence of a stranger at the sacrifice of the *gens*. Marriage itself is a sacrifice at which husband and wife officiate as priests, and their equality of status is attested by their solemnly eating together. The Roman *confarreatio* has its parallel in the *got kanāla* or 'tribal trencher' of the Punjab, the connubial meal by partaking of which the wife is transferred from her own exogamous group to that of her husband.

As with marriage so with food. The prohibition, which strikes us as so strange, against eating with members of another caste or partaking of food prepared by a man of lower caste recalls the religious significance which the Aryans attached to the common meal of the household. Cooked at the sacred fire, it symbolizes the unity of the family, its life in the present, its ties with the past. In Rome, as in India, daily libations were offered to ancestors; and the funeral feasts of the Greeks and Romans (περίδειπνον and *silicernium*) correspond to the *srāddha* of Hindu usage which, in M. Senart's view, represents 'an ideal prolongation of the family meal.' He seems even to find in the communal meals of the Persians,

and in the Roman *charistia*, from which were excluded not only strangers but any members of the family whose conduct had been unworthy, the analogue of the communal feast at which a social offender in India is received back into caste. The exclusion from religious and social intercourse symbolized by the Roman interdict *aqua et igni* corresponds to the ancient Indian ritual for expulsion from caste, where a slave fills the offender's vessel with water and solemnly pours it out on the ground, and to the familiar formula *hukka pānī band karna*, in which the modern luxury of tobacco takes the place of the sacred fire of the Roman excommunication. Even the caste *panchāyat* that wields these formidable sanctions has its parallel in the family councils which in Greece, Rome, and ancient Germany assisted at the exercise of the *patria potestas*, and in the chief of the *gens* who, like the *mātabar* of a caste, decided disputes between its members and gave decisions which were recognized by the state.

How was it that out of this common stock of usage there arose institutions so antagonistic in their nature as the castes of India and the nations of Europe? To what causes is it due that among the Aryans of the West all the minor groups have been absorbed in the wider circle of national unity, while the Indian Aryans have nothing to show in the way of social organization but a bewildering multitude of castes and sub-castes? M. Senart suggests a cause, but makes no attempt to follow out or illustrate its workings. He says, 'L'Inde ne s'est élevée ni à l'idée de l'État ni à l'idée de la Patrie. Au lieu de s'étendre, le cadre s'y resserre. Au sein des républiques antiques la notion des classes tend à se résoudre dans l'idée plus large de la cité; dans l'Inde elle s'accuse, elle tend à se circonscrire dans les cloisons étroites de la caste. N'oublions pas qu'ici les immigrans se répandaient sur une aire immense; les groupemens trop vastes étaient condamnés à se disperser. Dans cette circonstance les inclinations particularistes puisèrent un supplément de force.'

Distribution over a wide area, tending to multiply groups; contact with the aborigines, encouraging pride of blood; the idea of ceremonial purity, leading to the employment of the indigenous races in occupations involving manual labour, while the higher pursuits were reserved for the Aryans; the influence of the doctrine of metempsychosis, which assigns to every man a definite status determined by the inexorable law of *karma*; the absence of any political power to draw the scattered groups together; and the authority which the Brāhmanical system gradually acquired—these seem to be the main factors of

M. Senart's theory of caste. It may be urged in favour of his view of the subject that evolution, especially social evolution, is a gradual and complex process, that many causes work together to produce the final result, and that the attempt to reduce them to a single formula carries with it its own refutation. On the other hand, as Dr. Fick has pointed out[1], if caste were a normal extension of the ancient Aryan family system, the absence of any traces of this tendency in the Vedas is hardly accounted for by the statement that development proceeded so slowly, and was based on such primitive and instinctive impulses, that we could scarcely expect to find any tangible indications of it in a literature like that of the Hymns.

Caste not merely occupation.

Before proceeding farther we may dispose of the popular notion that community of occupation is the sole basis of the caste system. If this were so, as M. Senart has effectively pointed out, the institution 'aurait montré moins de tendance à se morceler, à se disloquer; l'agent qui l'aurait unifiée d'abord en aurait maintenu la cohésion.' To put it in another way, if the current idea were correct, all cultivators, all traders, all weavers ought to belong to the same caste, at any rate within the same area. But every one knows that this is not the case; that the same occupation embraces a whole crowd of castes each of which is a close corporation, though the members of each carry on the avocation that is common to them all.

The guilds of mediaeval Europe.

Several writers have laid stress on the analogy between Indian castes and the trade guilds of mediaeval Europe. The comparison is misleading. In the first place the guild was never endogamous in the sense that a caste is: there was nothing to prevent a man of one guild from marrying a girl of another. Secondly, there was no bar to the admission of outsiders who had learned the business: the guild recruited smart apprentices, just as the Baloch and Brāhui open their ranks to a fighting man who has proved his worth. The common occupation was a real tie, a source of strength in the long struggle against nobles and kings, not a symbol of disunion and weakness like caste in India. If the guild had been a caste, bound by rigid rules as to food, marriage, and social intercourse, and split up into a dozen divisions which could not eat together or intermarry, the wandering apprentice who was bound to travel for a year from town to town to learn the secrets of his art could hardly have managed to exist, still less could he have discharged, like Quintin Matsys and a host of less famous

[1] Fick, *loc. cit.*, p. 3.

craftsmen, the traditional duty of marrying his master's daughter. A guild may expand and develop; it gives free play to artistic endeavour; and it was the union of the guilds that gave birth to the Free Cities of the Middle Ages. A caste is an organism of a lower type; it grows by fission, and each step in its growth detracts from its power to advance or even to preserve the art which it professes to practise.

Caste tendencies under the Roman Empire.

A curious illustration of the inadequacy of occupation alone to generate and maintain the instinct of caste as we see it at work in India is furnished by certain ordinances of the Theodosian code. In the early part of the fifth century, when the Western Roman Empire was fast falling to pieces, an attempt was made, from purely fiscal motives, to determine the status and fix the obligations of all classes of officials. In his fascinating account of the constitution of society in those days, Professor Dill tells us how 'an almost Oriental system of caste' had made all public functions hereditary, 'from the senator to the waterman on the Tiber or the sentinel at a frontier post[1].' The Navicularii who maintained vessels for transport by sea, the Pistores who provided bread for the people of Italy, the Pecuarii and Suarii who kept up the supply of butcher's meat, were all organized on a system as rigid and tyrannical as that which prevails in India at the present day. Each class was bound down to its characteristic occupation, and its matrimonial arrangements were governed by the curious rule that a man must marry within the caste, while if a woman married outside of it her husband thereby acquired her status and had to take on the public duties that went with it. This surprising arrangement was not a spontaneous growth, like caste in India, but owed its existence to a law enforced by executive action. 'One of the hardest tasks of the Government (says Mr. Dill) was to prevent the members of these guilds from deserting or evading their hereditary obligations. It is well known that the tendency of the later Empire was to stereotype society, by compelling men to follow the occupation of their fathers, and preventing a free circulation among different callings and grades of life.... It was the principle of rural serfdom applied to social functions. Every avenue of escape was closed. A man was bound to his calling not only by his father's but by his mother's condition[2]. Men were not permitted to marry out of their guild. If the daughter of one of

[1] *Roman Society in the Last Days of the Western Empire*, Book iii, chap. i.

[2] C. Th. xiv. 4, 8 'ad munus pristinum revocentur, tam qui paterno quam materno genere inveniuntur obnoxii.'

the baker caste married a man not belonging to it, her husband was bound to her father's calling. Not even a dispensation obtained by some means from the imperial chancery, not even the power of the Church, could avail to break the chain of servitude.' There was even a caste of *curiales* or, as we should say in India, municipal commissioners, of whom we read that at a certain time all of them were ordered back to their native cities, and were forbidden to evade their hereditary obligations by entering any branch of the government service. As the Empire broke up, the caste system vanished with it. Men hastened to shake off all artificial restrictions and to choose wives and professions for themselves. But on the theory that community of function is the sole causative principle of caste, that is the last thing that they ought to have done. They should have hugged their chains and proceeded to manufacture new castes or sub-castes to fit every new occupation that sprang up. If the principle had been worth anything, it should have operated in Europe as effectually as it does in India. No one can say that the Theodosian code had not given it a good start.

Castes not merely developed tribes.

But, it will be asked, if the origin of caste is not to be found in the trade guild may we not seek it in the more primitive institution of the tribe? Early society, as far back as we can trace it, is made up of a network of tribes, and in India it is easy to observe the process of the conversion of a tribe into a caste. The conjecture seems at first sight plausible; but a glance at the facts will show that the transformation in question is confined to those tribes which have been brought into contact with the regular caste system, and have adopted its characteristic usages from religious or social motives. The Manipurīs, for example, were converted from Nāgās into Hindus only a century or two ago. The Bhumij, again, were a tribe at a still more recent date and retain plentiful traces of their origin. On the other hand, the races of Baluchistān, where Hindu influence is practically non-existent, show no inclination to follow the example of the Indian Muhammadans and organize themselves on the model of caste. The primitive tribe, in fact, wherever we find it, is not usually endogamous, and, so far from having any distaste for alien marriages, makes a regular business of capturing wives. In short, when tribes are left to themselves they exhibit no inborn tendency to crystallize into castes. In Europe, indeed, the movement has been all in the opposite direction: the tribes consolidated into nations; they did not sink into the political impotence of caste.

The genesis of caste. The basis of facts.

In the case of a complex phenomenon such as caste, to the formation of which a number of subtle tendencies must have contributed, all that we can hope to do is to disentangle one or two leading ideas and to show how their operation may have produced the state of things that actually exists. Following out this line of thought, it seems possible to distinguish two elements in the growth of caste sentiment: a basis of fact and a superstructure of fiction. The former is widespread if not universal; the latter peculiar to India. Whenever in the history of the world one people has subdued another, whether by sudden invasion or by gradual occupation of their territory, the conquerors have taken the women of the country as concubines or wives, but have given their own daughters in marriage only among themselves. Where the two peoples are of the same race, or at any rate of the same colour, this initial stage of hypergamy soon passes away and complete amalgamation takes place. Where, on the other hand, marked distinctions of race and colour intervene, and especially if the dominant people are continually recruited by men of their own blood, the course of evolution runs on different lines. The tendency then is towards the formation of a class of half-breeds, the result of irregular unions between men of the higher race and women of the lower, who marry only among themselves and are to all intents and purposes a caste. In this literal or physiological sense caste is not confined to India. It occurs in a pronounced form in the Southern States of the American Republic, where negroes intermarry with negroes, and the various mixed races, mulattoes, quadroons, and octoroons, each have a sharply restricted *ius connubii* of their own and are practically cut off from legal unions with the white races. The same set of phenomena may be observed among the half-breeds of Canada, Mexico, and South America, and among the Eurasians of India, who do not intermarry with natives and only occasionally with pure-bred Europeans. Illustrations of the same process may be observed in the Himālayas, where, if anywhere in India, the practices recorded with exaggerated precision in the Indian law books still survive. The Rājputs of the Kāngra Hills and the Khas of Nepāl are believed to be the offspring of alliances between conquering Rājputs and women of more or less Mongoloid descent. Working from this analogy, it is not difficult to construct the rough outlines of the process which must have taken place when the second wave of Indo-Aryans made their way into India through Gilgit and Chitrāl. To start with, they formed a homogeneous

community, scantily supplied with women, which speedily outgrew its original habitat. A company of the more adventurous spirits set out to conquer for themselves new domains among the neighbouring Dravidians. They went forth as fighting men, taking with them few women or none at all. They subdued the inferior race, established themselves as conquerors, and captured women according to their needs. Then they found themselves cut off from their original stock, partly by distance and partly by the alliances they had contracted. By marrying the captured women they had, to some extent, modified their original type; but a certain pride of blood remained to them, and when they had bred females enough to serve their purposes and to establish a distinct *ius connubii*, they closed their ranks to all further intermixture of blood. When they did this they became a caste like the castes of the present day. As their numbers grew, their cadets again sallied forth in the same way, and became the founders of Rājput and pseudo-Rājput houses all over India. In each case complete amalgamation with the inferior race was averted by the fact that they only took women and did not give them. They behaved in fact towards the Dravidians whom they conquered in the same way as some planters in America behaved to the African slaves whom they imported. This is a rough statement of what we may take to be the ultimate basis of caste, a basis of fact common to India and to certain stages of society all over the world. The principle upon which the system rests is the sense of distinction of race indicated by differences of colour: a sense which, while too weak to preclude the men of the dominant race from intercourse with the women whom they have captured, is still strong enough to make it out of the question that they should admit the men whom they have conquered to equal rights in the matter of marriage.

Influence of fiction.

Once started in India, the principle was strengthened, perpetuated, and extended to all ranks of society by the fiction that people who speak a different language, dwell in a different district, worship different gods, eat different food, observe different social customs, follow a different profession, or practise the same profession in a slightly different way must be so unmistakably aliens by blood that intermarriage with them is a thing not to be thought of. Illustrations of the working of this fiction have been given already and might be multiplied indefinitely. Its precise origin is necessarily uncertain. All that can be said is that fictions of various kinds have contributed largely to the development of early societies

in all parts of the world, and that their appearance is probably due to that tendency to vary, and to perpetuate beneficial variations, which seems to be a law of social no less than of physical development. However this may be, it is clear that the growth of the caste instinct must have been greatly promoted and stimulated by certain characteristic peculiarities of the Indian intellect—its lax hold of facts, its indifference to action, its absorption in dreams, its exaggerated reverence for tradition, its passion for endless division and subdivision, its acute sense of minute technical distinctions, its pedantic tendency to press a principle to its farthest logical conclusion, and its remarkable capacity for imitating and adapting social ideas and usages of whatever origin. It is through this imitative faculty that the myth of the four castes—evolved in the first instance by some speculative Brāhman, and reproduced in the popular versions of the Rāmāyana which the educated Hindu villager studies as diligently as the English rustic used to read his Bible—has attained its wide currency as the model to which Hindu society ought to conform. That it bears no relation to the actual facts of life is, in the view of its adherents, an irrelevant detail. It descends from remote antiquity, it has the sanction of the Brāhmans, it is an article of faith, and every one seeks to bring his own caste within one or other of the traditional classes. Finally, as M. Senart has pointed out, the whole caste system, with its scale of social merit and demerit and its endless gradations of status, is in remarkable accord with the philosophic doctrine of transmigration and *karma*. Every Hindu believes that his spiritual status at any given time is determined by the sum total of his past lives: he is born to an immutable *karma*, what more natural than that he should be born into an equally immutable caste?

The conclusions which this chapter seeks to establish may now be summed up. They are these:— Summary.

(1) There are seven main physical types in India, of which the Dravidian alone is, or may be, indigenous. The Indo-Aryan, the Mongoloid, and the Turko-Irānian types are in the main of foreign origin. The Aryo-Dravidian, the Mongolo-Dravidian, and the Scytho-Dravidian are composite types formed by crossing with the Dravidians.

(2) The dominant influence in the formation of these types was the physical seclusion of India, involving the consequence that the various invaders brought few women with them and took the women of the country to wife.

(3) To this rule the first wave of Indo-Aryans formed the sole exception, for the reasons given on pages 300–3.

(4) The social grouping of the Indian people comprises both tribes and castes. We may distinguish three types of tribe and seven types of caste.

(5) Both tribes and castes are subdivided into endogamous, exogamous, and hypergamous groups.

(6) Of the exogamous groups a large number are totemistic.

(7) Castes can be classified only on the basis of social precedence, but no scheme of classification can be framed for the whole of India.

(8) The Indian theory of caste was perhaps derived from Persia. It has no foundation in fact, but is universally accepted in India.

(9) The origin of caste is from the nature of the case an insoluble problem. We can only frame more or less plausible conjectures, derived from the analogy of observed facts. The particular conjecture now put forward is based—firstly, upon the correspondence that can be traced between certain caste gradations and the variations of physical type; secondly, on the development of mixed races from stocks of different colour; and thirdly, on the influence of fiction.

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CHAPTER VII

LANGUAGES

Our knowledge of most of the modern vernaculars of India has been much extended during the interval which has elapsed since the last edition of this *Gazetteer* was published. Not only have the highways of inquiry been widened and more clearly defined, but pioneers have ventured into the little-touched jungle of uncultivated dialects. There they have opened out paths which have sometimes led to unexpected results, and have disclosed secrets little suspected by those whose feet were necessarily confined to the main track that had previously been laid down with so much skill and energy. The progress has been most conspicuous in regard to the Aryan languages. The late Mr. Beames's *Comparative Grammar*, a book to the learning and lucidity of which worthy tribute was paid in 1886, was quickly succeeded by the similar work of Dr. Hoernle. The *Grammar of Eastern Hindī*, written by that eminent scholar, occupied much the same ground as the volumes of Mr. Beames, but carried the inquiries farther, and cast the main results into a form which has ever since been almost universally accepted. What has subsequently been done has principally dealt with matters of detail, or with the investigation of new languages of which satisfactory grammars did not previously exist. Linguistic progress.

Our knowledge of the Indo-Chinese languages has also made considerable progress. The Assam Government has liberally encouraged the production of textbooks of the forms of speech current in that polyglot territory ; and, in Europe, scholars like Professor E. Kuhn, of Munich, Professor Conrady, formerly of Leipzig, and Pater W. Schmidt, of Vienna, have succeeded in reducing to something like order the amazing confusion which hitherto existed in this department of philology. The Muṇḍā languages, too, have received considerable attention. New grammars and dictionaries have seen the light, and, in Europe, Scandinavian scholars have made a special study of this family of tongues. Theories of the most wide-

reaching significance have been put forth concerning them, but these have not yet all earned general acceptance.

In regard to the Dravidian languages, on the other hand, our knowledge has been almost stationary. Bishop Caldwell's monumental *Comparative Grammar of the Dravidian Languages*, which was fully utilized in the last edition of this *Gazetteer*, still remains our one authority. Only a few grammars of unimportant tribal dialects, such as Goṇḍ, Kurukh, and Kandh, together with one or two more grammars and dictionaries of the well-known classical languages of Southern India, have appeared during the past two decades.

The final word has not, however, been said regarding any of the Indian vernaculars, not even the Aryan ones. While we know a good deal about some of the languages, our information as to the dialects is, with one or two exceptions, most incomplete. Even in respect to the forms of speech with which we are familiar, and whose habitats are matters of commonplace, we often do not know where these habitats begin or end. There are many languages, too, spoken by wild tribes of the Hindu Kush, or of Further India, of which we know little or nothing except the names. A consideration of these facts has led the Government of India to commence a systematic survey of all the forms of speech employed in Northern and Eastern India, and in the Presidency of Bombay. This is rapidly approaching completion, and we may hope that its results when published will materially increase the world's information regarding one of its most interesting language-fields. So far as these results are available, they have been incorporated in the present chapter.

All this is a subject about which natives of India, a land whose literary glory may almost be said to be founded on the labours of its indigenous grammarians, are curiously incurious. Few natives at the present day are able to comprehend the idea connoted by the words 'a language.' Dialects they know and understand. They separate them and distinguish them with a meticulous, hair-splitting subtlety, which to us seems unnecessary and absurd; but their minds are not trained to grasp the conception, so familiar to us, of a general term embracing a number of interconnected dialects. It is as if we, in England, spoke of 'Somersetshire' and 'Yorkshire' dialects, but never used the term 'English language.' It thus follows that, while the dialect-names in the following pages have been taken from the indigenous nomenclature, nearly all the language-names have had to be invented by Europeans. Some

of them, such as 'Bengali,' 'Assamese,' and the like, are founded on words which have received English citizenship, and are not real Indian words at all; while others, like 'Hindostānī,' 'Bihārī,' and so forth, are based on already existing Indian names of countries or nationalities.

The vernaculars of India.

Five great families of human speech have their homes, as vernaculars, in India. These are the Aryan, the Dravidian, the Muṇḍā, the Mon-Khmer, and the Tibeto-Chinese. If, under the name of 'India,' we include the territories subject to Aden, we have to add at least two more, the Semitic and the Hamitic. These families will now be described in the above order. The oldest languages of India are probably those which we class as Muṇḍā, and if we arranged our subjects according to priority of occupation, we should have to commence with them. But practical reasons compel us to begin with the Aryan forms of speech, for, whether we consider the influence which they have exercised upon the development of Indian civilization, or the total number of their speakers, they are by far the most important.

The Aryan languages.

The modern Aryan vernaculars, although derived from languages which were highly synthetical in structure, with grammars as complicated as those of Latin or Greek, are now essentially analytical. As was said in the last edition of this work, the terminals of their nouns and verbs have given place to postpositions, and to disjointed modern particles to indicate time, place, and relation. The process was spontaneous, and it represents the natural course of the human mind. 'The flower of synthesis,' to use the words at once eloquent and accurate of Mr. Beames, 'budded and opened; and when full-blown began, like all other flowers, to fade. Its petals, that is, its inflexions, dropped off one by one; and in due course the fruit of analytical structure sprung up beneath it, and grew up and ripened in its stead.'

Originally the patois of pastoral tribes who found their way across the Hindu Kush, these tongues have spread over the whole of Northern India as far as Dibrugarh in the extreme east of Assam, and reaching south to Kanara in Bombay. While the speakers have in most instances succumbed to the influences of climate, and have lost their ethnical type by intermixture with the numerically superior aborigines, the languages have preserved their identity, and have superseded, and are still superseding, the indigenous forms of speech. When an Aryan tongue comes into contact with an uncivilized aboriginal one, it is invariably the latter which goes to the

wall. The Aryan does not attempt to speak it, and the necessities of intercourse compel the aborigine to use a broken 'pigeon' form of the language of a superior civilization. As generations pass this mixed jargon more and more approximates to its model, and in process of time the old aboriginal language is forgotten and dies a natural death. At the present day, in ethnic borderlands, we see this transformation still going on, and can watch it in all stages of its progress. It is only in the south of India, where aboriginal languages are associated with a high degree of culture, that they have held their own. The reverse process, of an Aryan tongue being superseded by an aboriginal one, never occurs.

The Indo-Europeans.

The Aryan languages form one branch of the great Indo-European family of speeches. The original home from which the populations whom we now group together under the title of 'Indo-European'[1] spread over Europe and parts of Western and Southern Asia has been a subject of long discussion, extending over many years. It has been located on the Caucasus and on the Hindu Kush. Other scholars maintained that it was in North-western Europe. Others have claimed Armenia and the country round the Oxus and Jaxartes as the centre of dispersion. The latest researches tend to show that the oldest domicile of the Indo-Europeans is probably to be sought for on the common borderland of Europe and Asia—in the steppe country of Southern Russia. Here they were a pastoral people; here some of their number took to agricultural pursuits; and from here they wandered off to the east and to the west.

From the point of view of language, the first great division of the Indo-Europeans was into the so-called *centum*-speakers and *satem*-speakers. The former, who originally began the word for 'hundred' with the letter *k*, travelled westwards and do not concern us. The latter, who expressed the same idea with some word beginning with a sibilant, mostly wandered to the east, and from their language have descended the speech-families which we call Aryan, Armenian, Phrygian, Thracian, Illyrio-Albanian, and Balto-Sclavonic. We have only to do with the first of these six.

One of the clans of these *satem*-speakers, who called themselves Aryans, migrated eastwards, probably by a route north of the Caspian Sea. They settled in the country lying on the

[1] The Indo-Europeans are often called 'Aryans,' but in this chapter the term is reserved for the Aryans properly so called,—the Indo-European clan which migrated into India and Persia.

banks of the Jaxartes and the Oxus, and we may, with some certainty, name the oasis of Khiva as one of their most ancient seats. Thence, still a united people, they worked their way up the courses of these rivers into the highlands of Khokand and Badakhshān, where they split up into two sections, one portion marching south, over the Hindu Kush, into the valley of the Kābul, and thence into the plains of India, and the other eastwards and westwards, towards the Pāmirs and towards what is now Merv and Eastern Persia. After the separation, the common Aryan speech developed on two different lines, and became, on the one hand, the parent of the Indo-Aryan, and, on the other hand, the parent of the Eranian (often spelt 'Iranian') family of languages.

The Eranians who journeyed eastwards penetrated even as far as Yarkand, but their language, as a national speech, has survived only in the Pāmirs, and its eastern limit may be taken as Sariqol. Those who travelled to the west ultimately occupied not only Merv, but the whole of Persia and Baluchistān, and nearly the whole of Afghānistān. At the earliest period of which we have documentary evidence, we find Eranian divided into two not very different dialects, commonly called Persic and Medic. Persic was the official language of the Court of the Achaemenides, and was employed by Darius I (B.C. 522–486), in the celebrated Behistun inscription. It developed into the Middle Persian or Pahlavī of the Sassanids (third to seventh centuries A.D.), and finally became modern Persian. Persian is not a vernacular of India; but under Musalmān dominion it became one of the great vehicles of Indian literature, and some of the most famous Persian books, including the great lexicographical works, have been composed in Hindustān. Medic, on the other hand, was the language of the Avesta. It was spoken not only in Media (North-western Persia), but all over East Erān. From it are descended the two great Eranian languages belonging to India—Pashto and Baloch; and also, besides others, the so-called Ghalchah languages of the Pāmirs and Sariqol. Eranian languages.

Commencing from the south, the first of these is Baloch. It is in its outward shape the most archaic of all the Eranian tongues, still possessing forms which fifteen hundred years ago had already begun to decay in the cognate Persian. As its name implies, it is the principal language of Baluchistān, and is geographically split up by the Dravidian-speaking Brāhūīs of the central hills into two dialects—that of the north, and that of Makrān in the south and west. Its Baloch.

southern boundary is the Arabian Sea, from near the Indus to about the fifty-eighth degree of east longitude. Northwards it extends to near Quetta, and as we go westwards it is found even farther than this, up to the valley of the Helmand. The Indus valley itself is occupied by speakers of Indo-Aryan languages, but the eastern boundary of Baloch follows the course of that river at a short distance to the west up to about Dera Ghāzi Khān. The northern dialect is much more rich in Indian loan-words than is Makrānī, and both dialects borrow freely from Arabic and Persian, words from the former often appearing in curiously distorted forms. Baloch can hardly be called a written language, although both the Persian and the Roman alphabets have been employed for transcribing it. The number of speakers of Baloch returned at the Census of 1901 was 152,188.

Pashto. To the north of Baloch lies Pashto, the main language of British and independent Afghānistān. In the latter it is not the vernacular of the Hazāra country or of the tract lying to the north of the Kābul river, including Laghmān and Kāfiristān, but elsewhere it is in general use. It is the principal language of Swāt and Buner, and of the country to the west of the Indus as far south as Dera Ismail Khān. The Indus is almost, but not quite, the eastern boundary; for, while the valley itself in its lower course is peopled by speakers of Indo-Aryan dialects, in the north Pashto has crossed the river and occupied parts of the British Districts of Hazāra and Rāwalpindi. As a *lingua franca* it is in common use still farther up the Indus, at least as far as the junction with the river Kāndia where the Indus turns to the south. It was returned as spoken by 1,224,807 people in British India at the Census of 1901, the area in which it is employed being bilingual. Pashto is spoken by Pathāns, while the Hindus employ an Indo-Aryan dialect locally known as Hindko.

Unlike Baloch, Pashto is a written language possessing an alphabet of its own based on that employed for Persian, and has a fairly copious literature. It has been the subject of considerable study, not only by English scholars, but also by Russians, French, and Germans. The rugged character of its sounds suits the nature of its speakers and of the mountains which form their home, but they are most inharmonious to the fastidious Oriental ear. Although harsh-sounding, it is a strong, virile language, which is capable of expressing any idea with neatness and accuracy. It is less archaic in its general characteristics than Baloch, and has

borrowed not only much of its vocabulary, but even part of its grammar, from Indian sources. It has two recognized dialects, a north-eastern, or Pakhto, and a south-western, or Pashto, which differ little except in pronunciation, the two names being typical examples of the respective ways of uttering the same word. Each has many tribal sub-dialects, which again differ merely in the pronunciation of the vowels. There is, for instance, the Afrīdī sub-dialect, noted for the broad sound of its *ā*; while the Wazīrīs change every *ā* to *ō*, and every *ū* to *ī*.

The Pathāns have been identified with the Pakthas, a tribe mentioned in the Rig-veda, and with the Πάκτυες of Herodotus; while the Ἀπάρυται of the Father of History are probably the same as the Afrīdīs, or, as they call themselves, Aprīdīs.

Ormurī.

Allied to Pashto, although quite a distinct language, is Ormurī, spoken by a small tribe settled round Kānigoram in Wazīristān. It is employed by members of the Bargistā tribe, who claim to be descendants of the Bārakīs that accompanied Mahmūd of Ghazni in his invasions of India. These Bārakīs are said to have taken a prominent part in the capture of the famous gates of Somnāth, and, pleased at the service rendered by them, the Sultān gave them a perpetual grant of the country round Kānigoram. The language, like Pashto, belongs to the Medic branch of Eranian speech. It is even more inharmonious than Pashto, and possesses one consonant, imperfectly represented in English letters by *kshr*; which even Pathān mouths find difficult to pronounce.

The Ghalchah languages.

The only other Eranian languages with which we are called upon to deal are the Ghalchah languages of the Pāmirs. The home of these tongues, Wakhī, Shighnī, Sariqolī, Ishkāshamī, and Munjānī, is beyond the British frontier; but the last-named has crosed the Hindu Kush by the Dora pass, and is also spoken in the Leotkuh valley of Chitrāl, where it is known as Yūdghā. This differs considerably from the standard language of Munjān, and has developed into an independent dialect. The spill of an Eranian language over the great watershed of the Hindu Kush is but a repetition of what occurred centuries ago when the Aryans first settled in the Pāmirs. At that early time, if linguistic evidence may be accepted, some of these Aryans crossed the passes and settled in what is now Laghmān, Kāfiristān, Chitrāl, Gilgit, and Kashmīr. They migrated at a period when all the typical characteristics of Eranian languages had not yet become fixed, and in their new home their tongue developed on its own

The Piśācha languages.

lines, partly Eranian and partly Indo-Aryan. The Aryans of India proper, who had entered the Punjab by the valley of the Kābul, had little intercourse or sympathy with these tribes, and nicknamed them *Piśāchas*, or flesh-eaters, ὠμοφάγοι, and in later years gruesome traditions attached to the name.

These Piśācha tribes must at one time have extended to some distance beyond their present seats. Sanskrit writers mention colonies of them in the Western Punjab and in Sind, and examples of the dialects spoken by them are found in the words which the Greeks employed to record names heard by them in North-western India, and in the versions of the inscriptions of Asoka found in the same locality. Indeed, there are traces of their influence still existing in the modern vernaculars of the Lower Indus valley. At the present day the languages are found only in the country between the Punjab and the Hindu Kush. They possess an extraordinarily archaic character. Words are still in everyday use which are almost identical with the forms they assumed in Vedic hymns, and which now survive only in a much corrupted state in the plains of India.

In their essence these languages are neither Eranian nor Indo-Aryan, but are something between both. In the southern portion of the area in which they are spoken they are much mixed with Indian idioms; and this is specially the case with Kāshmīrī, which has only a Piśācha substratum, overlaid by another language of Indian origin, which so effectually conceals the original basis, that Kāshmīrī must now be considered as Indo-Aryan, and not as belonging to the Piśācha group.

The true Piśācha languages of the present day are Pashai, spoken in Laghmān of Afghānistān; a number of Kāfir dialects, of which the principal are Bashgalī, Wai, and Kalāshā; Khowār, the language of Chitrāl; and Shīnā, that of Gilgit and the neighbourhood. It is Shīnā which is the basis of Kāshmīrī, and it is also the foundation of several mixed dialects, spoken in the Indus and Swāt Kohistāns, which are now being superseded by Pashto. Khowar occupies a somewhat independent position in regard to the others, while the Kāfir dialects, of which there are at least five, differ considerably among themselves. Wasiñ Veri, the most western of them, in some phonetic peculiarities shows points of agreement with the purely Eranian Munjānī. All the Piśācha languages are without literatures, and have been reduced to writing only in the past few years by European scholars. At the same time it may be remarked that the great collection of

Indian folk-lore entitled the *Bṛihat Kathā*, of which no copy is known to exist at the present day, is said by tradition to have been composed in the tongue of the Piśāchas.

Indo-Aryan languages. Returning to the immigration of the Indo-Aryans through the Kābul valley from the west, it is not suggested that this took place all at once. On the contrary, it was a gradual affair extending over centuries. The latest comers would not necessarily be on good terms with their predecessors, who quite possibly opposed them as intruders, nor did they speak the same language. At the earliest period of which we have any cognizance, we see the Punjab peopled by various Indo-Aryan tribes, one at enmity with another, and sometimes alluding to its opponent as a set of unintelligible barbarians.

The language of the 'Midland.' In Sanskrit geography India is divided into the *Madhya-deśa*, or 'Midland,' and the rest. The Midland is constantly referred to as the true pure home of the Indo-Aryan people, the rest being, from the point of view of Sanskrit writers, more or less barbarous. The Midland extended from the Himālayas on the north to the Vindhya Hills on the south, and from Sahrind (*vulgo* Sirhind) in the Eastern Punjab on the west to the confluence of the Ganges and the Jumna on the east. It thus consisted of the Gangetic Doāb, and of the country immediately to its north and south. The population of this tract had expanded from its original seat near the Upper Doāb and the sacred river, the Saraswatī. The particular Indo-Aryan dialect of these people developed into the modern language of the Midland. It also received literary culture from the most ancient times, and became fixed, in the form of Sanskrit (literally the 'purified' language), by the labours of grammarians, which may be said to have culminated in the work of Pāṇini about the year 300 B.C. Sanskrit thus represents a polished form of an archaic tongue, which by Pāṇini's time was no longer a vernacular[1], but which, owing to political reasons and to the fact that it was the vehicle of literature, became a second language understood and used by the educated in addition to their mother tongue, and has so continued with a fluctuating popularity down to the present day. We may take the language of the Rig-veda as representing the archaic dialect of the Upper Doāb, of which Sanskrit became the polished form. It was a vernacular, and, besides receiving this literary cultivation, underwent the fate

[1] So in the opinion of the present writer. Some scholars consider that Sanskrit was a vernacular of certain classes in Pāṇini's time and for long afterwards. See *J. R. A. S.* for 1904, pp. 435 sq., 457 sq.

of all vernaculars. Just as the spoken dialects of Italy existed side by side with Latin, and, while the evolution of Latin was arrested by its great writers, ultimately developed into the modern Romance languages, so the ancient Vedic form of speech developed first into that stage of language known as Prākrit, and then into one or more modern Indo-Aryan vernaculars. It is thus a mistake to say that any modern Indian language is *derived* from Sanskrit. The most that can be said is that it and Sanskrit have a common origin.

The languages of the 'Outer Band.'

So far for the language of the 'Midland.' Round it, on three sides—west, south, and east—lay a country inhabited, even in Vedic times, by other Indo-Aryan tribes. This tract included the modern Punjab, Sind, Gujarāt, Rājputāna and the country to its east, Oudh, and Bihār. Rājputāna belongs geographically to the Midland, but it was a late conquest, and for our present purposes may be considered as belonging to the Outer Band. Over this band were scattered different tribes, each with its own dialect; but it is important to note that a comparison of the modern vernaculars shows that these outer dialects were all more closely related to each other than any of them was to the language of the Midland. In fact, at an early period of the linguistic history of India there must have been two sets of Indo-Aryan dialects—one the language of the Midland, and the other the group of dialects forming the Outer Band. From this it has been argued, and the contention is entirely borne out by the results of ethnological inquiries, that the inhabitants of the Midland represent the latest stage of Indo-Aryan immigration. The earliest arrivals spoke one dialect, and the new-comers another. According to Dr. Hoernle, who first suggested the theory, the latest invaders probably entered the Punjab like a wedge, into the heart of the country already occupied by the first immigrants, forcing the latter outwards in three directions, to the east, to the south, and to the west.

The next process which we observe in the geographical distribution of the Indo-Aryan languages is one of expansion. The population of the Midland increased, and history shows that it exercised an important influence over the rest of India. The imperial cities of Delhi and Kanauj, and the holy city of Mathurā (Muttra), the Μόδουρα ἡ τῶν θεῶν of Ptolemy, lay within its territory. With increased population and increased power it expanded and conquered the Eastern Punjab, Rājputāna and Gujarāt (where it reached the sea, and gained access to maritime commerce), and Oudh. With its armies and with

its settlers it carried its language, and hence in all these territories we now find mixed forms of speech. The basis of each is that of the Outer Band, but its body is that of the Midland. Almost everywhere the nature of the phenomena is the same. In the country near the borders of the Midland, the Midland language has overwhelmed the ancient language, and few traces of the latter can be recognized. As we go farther from the centre, the influence of the Midland weakens and that of the Outer Band becomes stronger and stronger, till the traces of the Midland speech disappear altogether. The present language of the Eastern Punjab is closely allied to that of the Upper Doāb, but it gradually becomes the Lahndā of the Western Punjab, which has nothing to do with the Midland. So the language of North-eastern Rājputāna is very similar to that of Agra, but as we go south and west we see more and more of the original language of the Outer Band, until it is quite prominent in Gujarāt. Again, in Oudh, which was a country with a literature and history of its own, there is a mixture of the same nature, although here the Midland language has not established itself so firmly as it has in the west and south.

Finally, where possible, the inhabitants of the Outer Band also expanded to the south and east. In this way we find Marāṭhī in the Central Provinces, Berār, and Bombay; and, to the east, Oṛiyā, Bengali, and Assamese, all of them true Outer languages unaffected in their essence by the speech of the Midland.

The state of affairs at the present day is therefore as follows:— There is a Midland Indo-Aryan language, occupying the Gangetic Doāb and the country immediately to its north and south. Round it on three sides is a band of Mixed languages, occupying the Eastern Punjab, Gujarāt, Rājputāna, and Oudh, with extensions to the south in Baghelkhand and Chhattīsgarh. Again, beyond these, there is a band of Outer languages, occupying Kashmīr, the Western Punjab, Sind (here it is broken by Gujarāt), the Marāṭhā country, Orissa, Bihār, Bengal, and Assam. To these should be added the Indo-Aryan languages of the Himālayas north of the Midland, which also belong to the Intermediate Band, being recent importations from Rājputāna. The Midland language is therefore now enclosed in a ring fence of intermediate forms of speech.

The Prākrits.

We have seen that the word 'Sanskrit' means 'purified.' Opposed to this is the word 'Prākrit,' or 'natural, unartificial.' 'Prākrit' thus connotes the vernacular dialects of

India as distinguished from the principal literary form of speech. The earliest Prākrit of which we have any cognizance is the Midland vernacular current during the Vedic period. We have no record of the contemporary Prākrits of the Outer Band. We may call all these vernaculars (including the tongue of the Midland) the *Primary* Prākrits of India. These Primary Prākrits were in a linguistic stage closely corresponding to that of Latin as we know it. They were synthetic languages, with fairly complicated grammars, and with no objection to harsh combinations of consonants. In the course of centuries they decayed into what are called *Secondary* Prākrits. Here we find the languages still synthetic, but diphthongs and harsh combinations are eschewed, till in the latest developments we find a condition of almost absolute fluidity, each language becoming an emasculated collection of vowels hanging for support on an occasional consonant. This weakness brought its own nemesis and from, say, 1000 A.D. we find in existence the series of modern Indo-Aryan vernaculars, or, as they may be called, *Tertiary* Prākrits. Here we find the hiatus of contiguous vowels abolished by the creation of new diphthongs, declensional and conjugational terminations consisting merely of vowels worn away, and new languages appearing, no longer synthetic, but analytic, and again reverting to combinations of consonants under new forms, which had existed three thousand years ago, but which two thousand years of attrition had caused to disappear.

Returning to the Secondary Prākrits, they existed from, at least, the time of the Buddha (550 B.C.) down to about 1000 A.D. During these fifteen hundred years they passed through several stages. The earliest was that now known as Pāli. Two hundred and fifty years before Christ, we find the edicts of Asoka written in a form of this language, and it then had at least two dialects, an eastern and a western. In this particular stage of Pāli one of the Secondary Prākrits was crystallized by the influence of Buddhism, which employed it for its sacred books. As vernaculars, the Secondary Prākrits continued the course of their development, and in a still more decayed form reached the stage of what, in various dialects, is known as The Prākrit *par excellence*. When we talk of Prākrits, we usually mean this later stage of the Secondary Prākrits, when they had developed beyond the stage of Pāli, and before they had reached the analytic stage of the modern Indo-Aryan vernaculars.

At this stage, so far as materials are available, we notice the same grouping of the Prākrit dialects as exists among the

vernaculars of the present day. We have no definite information what was the language of the Punjab; but as for the rest of India, there was a Prākrit of the Midland, the so-called Śaurasenī, called after the Sanskrit name, Śūrasena, of the country round Mathurā (Muttra). It was close to the great kingdom of Kanauj, the centre of Indo-Aryan power at this time. To its south and east was a band of dialects agreeing in many points among themselves, and also in common points of difference when compared with Śaurasenī. These were—in the east, in the country now called Bihār, Māgadhī; in Oudh and Baghelkhand, Ardhamāgadhī; and, south of Ardhamāgadhī and Śaurasenī, Māhārāshṭrī with its head quarters in Berār. Ardhamāgadhī, as might be expected, was partly a mixed language, showing signs of the influence of Śaurasenī, but, in all its essential points, its relationship with Māgadhī is undoubted. Māhārāshṭrī was closely connected with Ardhamāgadhī, which formed the connecting link between it and Māgadhī, but in its rather isolated position it struck out on somewhat independent lines. It is important to remember that it (under the name of Saurāshṭrī) was once the language of Gujarāt, before that country was overwhelmed by the invasion from the Midland.

Vidarbha, or Berār, the home of Māhārāshṭrī, was the seat of a powerful kingdom, whose rulers encouraged literature, not only in Sanskrit but also in the vernacular. Māhārāshṭrī received culture at an early period. In its native land it became the vehicle of some of the most charming lyrics ever composed in an Indian tongue; and its popularity carried it over the whole of Hindustān, where it was employed both for epic poetry and also by the later Jain religious writers. But it is best known from the Indian dramas, in which, while most of the vernacular prose was written in Śaurasenī, the language of the Midland, the songs are usually in Māhārāshṭrī[1].

The next and last stage of the Secondary Prākrits was that known as 'Literary Apabhraṁśa.' 'Apabhraṁśa,' meaning 'corrupt' or 'decayed,' was the title given by Indian grammarians, after the Prākrits had begun to receive literary culture, to the true vernaculars on which these polished literary dialects were founded. Ultimately, these Apabhraṁśas became themselves employed in literature, and were even studied by native grammarians, successors of those who in previous generations

The Apabhraṁśas.

[1] In the old Indian drama, Brāhmans, heroes, kings, and men of high rank are made to speak Sanskrit, other characters employing some Prākrit dialect.

had despised them. This was a mere repetition of history. Sanskrit became fixed, and in time ceased to be generally intelligible. Then the vernacular Pāli was used for popular literature. When literary Pāli became generally unintelligible, the vernacular Prākrit was employed for the same purpose. Prākrit itself became crystallized, and in the course of generations had to yield to Apabhraṁśa. While the earlier Prākrits had been manipulated for literary purposes by the omission of what was considered vulgar and by the reduction of wild luxuriance to classical uniformity, so that the result was more or less artificial, the Apabhraṁśas were not nearly so severely edited, and the sparse literature which has survived affords valuable evidence as to the actual spoken language at the time of its committal to writing. The modern vernaculars are the direct children of these Apabhraṁśas. The Śaurasena Apabhraṁśa was the parent of Western Hindī and Panjābī. Closely connected with it were Āvantī, whose head quarters were round what is now Ujjain, the parent of Rājasthānī; and Gaurjarī, the parent of Gujarātī. The remaining intermediate language, Eastern Hindī, is sprung from Ardhamāgadha Apabhraṁśa.

Turning to the Outer Band, an unnamed Apabhraṁśa was the parent of Lahndā and Kāshmīrī, the latter, as has been said, having as its base some Piśācha language akin to Shīnā, over which the modern language lies as a second layer. Sindhī is derived from a Vrāchaḍa Apabhraṁsa spoken in the country of the lower Indus, and Marāṭhī is the child of the Apabhraṁśa of Mahārāshṭra. In the east, the great Māgadha Apabhraṁśa is not only the parent of Bihārī in its proper home, but has also branched out in three directions. To the south it became Oṛiyā; to the south-east it developed into the Bengali of Central Bengal; while to the east, keeping north of the Ganges, its children are Northern Bengali, and, farther on, Assamese. These three branches can be distinctly traced. In some respects Oṛiyā and Northern Bengali preserve common features which have disappeared in Central Bengal.

Sanskrit. Concurrently with the development of the Indo-Aryan vernaculars, we have Sanskrit, the literary language of the Brāhmanical schools, endowed with all the prestige which religion and learning could give it. In earlier times its influence was strongest in its proper home, the Midland. Allowing for phonetic corruption, the vocabulary of Śaurasenī Prākrit is practically the same as that of Sanskrit. The farther we go from the Midland the more strange words we meet, words which are technically known as *deśya* or

'country-born.' These, though Indo-Aryan, are not descended from the particular archaic dialect from which Sanskrit sprang, but belong to the vocabularies of the dialects of distant parts of India which were contemporary with it. On the other hand, the prestige of the literary Sanskrit has exercised a constant influence over all the Aryan vernaculars of India. Universally, but wrongly, believed to be the parent of all of them, the would-be children have freely borrowed words from the vocabulary of their adoptive parent, and this tendency received an additional impetus with the revival of learning which dates from the early part of the last century. In some of the modern languages it then became the fashion to eschew as much as possible all honest vernacular words derived from the Prākrits, and to substitute borrowed Sanskrit words, much as if a Frenchman were to substitute the Latin *siccus* for his own *sec*, or as if an Englishman were to use the Anglo-Saxon *hlāford* instead of 'lord.' Native grammarians call these borrowed words *tatsamas*, or 'the same as "that" (sc. Sanskrit),' while the true vernacular words derived from Prākrit are *tadbhavas*, or 'having "that" (sc. Sanskrit) for its origin.' We thus see that the Aryan portion of the vocabulary of a modern Indo-Aryan vernacular is composed of three elements: *tatsamas*, *tadbhavas*, and *deśyas*. The distinction is of some importance, for the literary language of some of them, such as Bengali, is so overloaded with the fashionable *tatsamas* that it may almost be called a national misfortune. For the sake of a spurious dignity the written word has been rendered unintelligible to the vast multitudes who have not received the education imparted by the higher schools.

Other languages have contributed their quotas to the Indo-Aryan vernaculars. Many words have been borrowed from Dravidian languages, generally in a contemptuous sense. Thus the common word *pillā*, 'a cub,' is really a Dravidian word meaning 'son.' The most important additions have come from Persian, and through Persian from Arabic. These are due to the influence of Mughal domination, and their use is universal. Every peasant of Northern India employs a few, while the literary Urdū of Lucknow is so full of them, that little of the true vernacular remains except an occasional postposition or auxiliary verb. A few words also have been borrowed from Portuguese, Dutch, and English, often in quaintly distorted forms. Few Englishmen would recognize the railway term 'signal' in *sikandar*, which also, as a true Hindostānī word, means 'Alexander the Great.'

Indo-Aryan vernaculars.

We thus arrive at the following list of the modern Indo-Aryan vernaculars:—

	Number of speakers (1901).
A. Language of the Midland:	
Western Hindī	40,714,925
B. Intermediate languages:	
a. More nearly related to the Midland language.	
Rājasthānī	10,917,712
The Pahāṛī languages	3,124,681
Gujarātī	9,439,925
Panjābī	17,070,961
b. More nearly related to the Outer languages.	
Eastern Hindī	22,136,358
C. Outer languages:	
a. North-Western group.	
Kāshmīrī	1,007,957
Kohistānī	36
Lahndā	3,337,917
Sindhī	3,494,971
b. Southern language.	
Marāṭhī	18,237,899
c. Eastern group.	
Bihārī	34,579,844
Oṛiyā	9,687,429
Bengali	44,624,048
Assamese	1,350,846
Total	219,725,509

Of these, the Pahāṛī languages are offshoots of Rājasthānī spoken in the Himālayas. Kohistānī includes the mixed dialects of the Swāt and Indus Kohistāns. The Census of 1901 did not extend to these tracts, and hence few speakers were recorded. We now proceed to consider each of these forms of speech in the order of the above list.

Hindī.

The word 'Hindī' is very laxly employed by English writers. It properly means 'Indian,' and can be used to signify any Indian language. By Europeans it is sometimes reserved for a particular form of Hindostānī which will be described below, but is more often employed as a vague term to denote all the rural dialects of the three languages—Bihārī, Eastern Hindī, and Western Hindī—spoken between Bengal proper and the Punjab. In the present pages it is used only in the former of these two senses; that is to say, as meaning that form of Hindostānī which is the prose literary language of those Hindus who do not employ Urdū. In English 'Hindī' is specially applied to the languages of Oudh and of the Midland, and, to avoid the introduction of a strange terminology,

these are here called 'Eastern Hindī' and 'Western Hindī,' respectively. They are two quite distinct languages.

Western Hindī. Western Hindī is, therefore, the modern Indo-Aryan vernacular of the old Midland, i.e. of the Gangetic Doāb and the country to its north; and, as in ancient times, it is by far the most important of all the languages of India. It is true that speakers of Bengali exceed in number those whose vernacular is Western Hindī, but the forty millions shown above by no means exhaust the number of speakers of the latter. Bengali is confined to its own Provinces; but Hindostānī, the principal dialect of Western Hindī, is not only a local vernacular, but is also spoken over the whole of the north and west of continental India as a second language, a *lingua franca* employed alike in the court and in the market-place by every one with any claim to education. Hindostānī is that dialect of Western Hindī whose home is the Upper Gangetic Doāb, in the country round Meerut. The city of Delhi lies close to the southern border of this tract. Here the dialect was in general use, and from here it was carried everywhere in India by the lieutenants of the Mughal empire. It has received considerable literary cultivation at the hands of both Musalmāns and Hindus. The former employed the Persian character for recording it, and enriched its vocabulary with a large stock of Persian and Arabic words. When this infusion of borrowed words is carried to an extreme, as is the fashion, for instance, in Lucknow, the language is intelligible only to educated Musalmāns and to those Hindus who have been educated on Musalmān lines. This Persianized form of Hindostānī is known as Urdū, a name derived from the *Urdū-e mu'alla*, or royal military bazar outside Delhi Palace, where it took its rise. When employed for poetry, Urdū is called *Rekhta* ('scattered' or 'crumbled'), from the manner in which Persian words are 'scattered' through it. The extreme Persianization of Urdū is due to Hindu rather than to Musalmān influence. Although Urdū literature is Musalmān in its origin, the Persian element was first introduced in excess by the pliant Hindu Kāyasths and Khattīs employed in the Mughal administration and acquainted with Persian, rather than by Persians and Persianized Mughals, who for many centuries used only their own language for literary purposes[1]. In the Deccan, even where Dravidian languages are the principal vernaculars, Urdū is very generally employed by Musalmāns,

Urdū.

[1] See Sir Charles Lyall, in *A Sketch of the Hindustani Language*, p. 9.

and here Urdū literature took its rise. 'Dakhinī Hindostānī,' as it is called, differs somewhat from the modern standard of Delhi and Lucknow, and retains several archaic features which have disappeared in the north. During the first centuries of its existence Urdū literature was entirely poetical. Prose Urdū owes its origin to the English occupation of India, and to the need of textbooks for the College of Fort William. The Hindī form of Hindostānī was invented at the same time by the teachers at that college. It was intended to be a Hindostānī for the use of Hindus, and was derived from Urdū by ejecting all words of Arabic and Persian birth, and substituting in their place words borrowed or derived from the indigenous Sanskrit. Owing to the popularity of the first book written in it, and to its supplying the need for a *lingua franca* which could be used by the strictest Hindus without their religious prejudices being offended, it became widely adopted and is now the recognized vehicle for writing prose by those inhabitants of Upper India who do not employ Urdū. Although originally differing from that language merely in vocabulary, it has in the course of a century developed some idioms of its own, so that it is not often that one finds a native who can write both forms of Hindostānī with equal correctness. Indeed, there is one well-known book, written by a Muhammadan, which does not contain a single Arabic or Persian word from cover to cover, and which is nevertheless considered by Hindu purists to be written in Urdū, because idioms are found in it belonging to that form of the dialect, and not to Hindī.

Urdū, as becomes its origin, is usually written in a modified form of the Persian character, while Hindī is generally written, like Sanskrit, in the Deva-nāgarī character. While the former is enlisted into the service of both prose and poetry, the latter is employed only for prose. When a Hindu writes poetry he betakes himself to one of the naturally-born dialects of Eastern or Western Hindī, usually Awadhī or Braj Bhāshā. The name 'Hindostānī,' when connoting any particular form of speech, is properly reserved for a language whose vocabulary is neither excessively Persianized nor excessively Sanskritized.

The other dialects of Western Hindī are Bāngarū, Braj Bhāshā, Kanaujī, and Bundelī. The first is the language of the Bāngar, or highland of the South-eastern Punjab, immediately to the west of the Ganges. It is sometimes called Hariānī, and is much mixed with Panjābī and Rājasthānī. Of all the dialects, Braj Bhāshā is the nearest relative to Śaurasenī. It

is spoken round Mathurā (Muttra) and in the Central Gangetic Doāb. It has a copious literature, mainly poetical, and was the principal literary form of Western Hindī employed by Hindus before the invention of Hindī. Kanaujī is almost the same as Braj Bhāshā. It is spoken in the lower part of the Central Doāb as far down as, say, Cawnpore, and in the country to its north. Bundelī is the dialect of the greater part of Bundelkhand, and also of a good portion of the Narbadā valley in the Central Provinces. It has a respectable literature.

As languages, Western Hindī, and its neighbour Eastern Hindī, rival English in their flexibility and copiousness. When not spoiled, as Western Hindī too often is, by an excessive display of Arabic and Persian or of Sanskrit words, they are two beautiful, vigorous forms of speech, not overburdened by complicated grammars, and capable of expressing any idea which the mind of man can conceive with ease, elegance, and crystal clearness. They both have enormous native vocabularies, and each has a complete apparatus for the expression of abstract terms. Their old literatures contain some of the highest flights of poetry and some of the most eloquent utterances of religious devotion which have found their birth in Asia.

Turning to the Intermediate languages, we first deal with those in which the language of the Midland is the predominant feature. Rājasthānī and Gujarātī may be considered together, as representing the flow of the inhabitants of the Midland to the south-west, to meet the sea. Rājputāna, in which Rājasthānī is spoken, is divided into many states and many tribes. Each claims to have a language of its own, but all these are really dialects of one and the same form of speech. They fall into four main groups—a northern, a southern, an eastern, and a western. The typical dialect of the north is Mewātī or Bighotā. Of all the dialects of Rājputāna it is, as might be expected, that which most nearly resembles Western Hindī. To the north-east it shades off into Braj Bhāshā, and to the north-west into Bāngarū. Mālvī, the main dialect of Southern Rājputāna, is spoken in Mālwā. Neither it nor Mewātī has any literature to speak of. In Eastern Rājputāna we have Jaipurī, with many sub-dialects, and many closely connected forms of speech with various names. The western dialect, Mārwāṛī, is by far the most important. It is the vernacular of Mārwār, Mewār, Bīkaner, and Jaisalmer, and its speakers, who are enterprising merchants and bankers, have carried it all over India. It is the most typical of the Rājasthānī dialects,

Rājasthānī.

and has a copious literature, written in a peculiar character, the aspect of which is familiar to every Indian official who has had occasion to inspect the accounts of native bankers.

Pahāṛī. Rājputāna has sent out many colonies into Northern India. The most important are the inhabitants of the Himālayas from Chamba in the Punjab to Nepāl. Some centuries ago bands of Rājputs at various times invaded and conquered these hills. They settled there and intermarried with the original inhabitants, on whom they imposed their language. The Rājasthānī here transplanted has developed on independent lines, and was no doubt influenced by the form of speech which it superseded. What that form of speech was we do not know, except that we have some old plays in one of the original languages of Nepāl. This was akin to what is now modern Bihārī. The modern Rājasthānī dialect now spoken in Nepāl is called by Europeans 'Naipālī'—a wrong name, for it is not the main language of the country but is spoken only by the ruling classes. The other inhabitants employ various Tibeto-Burman dialects. Its speakers call it 'Khas,' from the name of one of the tribes which employ it. Farther west these dialects are simply called 'Pahāṛī,' or 'the Language of the Hills.' We have a Western Pahāṛī spoken north of the Central and Eastern Punjab, and a Central Pahāṛī north of the United Provinces. To these Khas may be added, under the name of 'Eastern Pahāṛī.' Other offshoots of Rājasthānī are Gujarī, the language of the Gūjars wandering with their herds over the mountains of Kashmīr and the Swāt valley; and Labhānī, spoken by the Labhānās or Banjārās, the great carrying tribe of Central and Western India. There are numerous Gūjars in the plains of the Punjab, where they have given their name to two Districts, but these nowadays speak ordinary Panjābī.

Gujarātī. Mārwār is bounded on the west by the Indian Desert, beyond which we find Sindhī, one of the Outer languages, but to the south we enter easily into Gujarāt. Gujarātī, the language of this country, is the most western of those over which the language of the Midland exercises sway, and at its base we can see distinct traces of the old Saurāshṭrī Prākrit, which belonged to the Outer Band. Gujarātī has a printed character of its own, modelled on the cursive form which Deva-nāgarī takes all over Northern India, especially in Mārwār. Owing to the survival of a number of ancient grammars, we have a connected history of the language from the time when it first came into existence as a modern Indo-Aryan vernacular some nine hundred years ago. Literature has always flourished in

Gujarāt from very early times, and the modern vernacular presents no exception. The Bhīls and the inhabitants of Khāndesh speak mixed forms of speech which are dialects of Gujarātī.

Panjābī.

Of all the Intermediate languages, Panjābī is the one which most nearly agrees with the modern speech of the Midland. It is spoken in the Central Punjab, and is the vernacular of the Sikhs. Immediately to its west lies Lahndā, an Outer language, and the change from the one to the other is most gradual. It is quite impossible to fix a definite boundary between these two, but we may take the seventy-fourth degree of east longitude as an approximate conventional dividing line. Lahndā once extended far to the east, but, as has been explained, was there superseded by the language of the Midland, whose influence gradually diminished as it went westwards. It is this mixed language which became the modern Panjābī. Its proper written character is related to that employed in Mārwār. It is known as *Laṇḍā*, or 'clipped' (quite a distinct word from *Lahndā*, the name of the language of the Western Punjab), and is distinguished for its illegibility when once it is put upon paper. Only its writer, and not always he, can read Laṇḍā as commonly scrawled. An improved, and legible, form of Laṇḍā is known as Gurmukhī. This was invented about three hundred years ago for writing the Sikh scriptures, and is now the character in ordinary use for printing, although the Persian and the Deva-nāgarī are also employed. The standard Panjābī is that spoken in the neighbourhood of Amritsar; and the only real dialect is Ḍogrī, the vernacular of the State of Jammu, and, with slightly varying inflexions, of a part of Kāngra. Of the languages connected with the Midland, Panjābī is the purest and most free from the burden of terms borrowed from either Persian or Sanskrit. While capable of expressing all ideas, it has a charming rustic flavour indicative of the national characteristics of the sturdy peasantry that use it.

Eastern Hindī.

The remaining Intermediate language is Eastern Hindī, which differs from the others in that it is based on the eastern languages of the Outer Band, and that the influence of the language of the Midland is not nearly so strong as in Rājputāna and the Punjab. Here the two elements meet in nearly equal proportions. It is the language of Oudh, of Baghelkhand, and of Chhattīsgarh in the Central Provinces, and has a long history behind it. It is the vernacular of the country in which the hero Rāma-chandra was born; and the Jain apostle Mahāvīra used an early form of it to convey his teaching to his disciples. The local Prākrit, Ardhamāgadhī, thus became the sacred

language of the Jains. Its modern successor, Eastern Hindī, through the work of a great genius, became the medium for celebrating the Gestes of Rāma, and, in consequence, the dialect employed for nearly all the epic poetry of Hindustān. It is spoken nowadays not only in its own tract, but is also used by uneducated Musalmāns far to the east—right into the heart of Bihār; and Oudh men, who are accustomed to travel to distant parts in quest of service, have carried it far and wide over the whole of India. It is commonly heard even in the streets of Calcutta and Bombay.

Eastern Hindī has a great literature, probably larger than that of any other of the modern Indo-Aryan vernaculars; and this literature, being founded on the genuine tongue of the people, and acquiring no fictitious dignity by bastard additions of Sanskrit words, has reacted on the spoken language, so that the form of speech heard in the fields of Oudh possesses the characteristic beauties of poetry and clearness. Every Oudh rustic is soaked in his national literature, and quotations from his great writers fall more naturally from his lips than the words of Burns fall from those of a Scotsman. Overshadowed at the present day by the official Hindostānī, it has been studied by but few Europeans, but no one who has once wandered into its magic garden ever leaves it willingly.

In the Central Provinces, Eastern Hindī meets Marāṭhī and shades off into that language through a number of mixed dialects. It and Oṛiyā are the only forms of speech which are not separated from Marāṭhī by a distinct dividing line, and it thus still bears witness to the intimate relationship which existed between the Ardhamāgadhī and the Māhārāshṭrī Prākrits two thousand years ago.

Eastern Hindī has three main dialects. Besides the standard Awadhī spoken in Oudh, there is the Baghelī of Baghelkhand, and the Chhattīsgaṛhī of the eastern part of the Central Provinces.

Kāshmīrī.

It will have been noticed that the Outer languages have been divided in the table given on p. 364 into three sets, a north-western group, a southern language, and an eastern group. Owing to its somewhat isolated position, and to the influence of the Piśācha languages already referred to, the north-western group, although closely agreeing with the other two in its general structure, has struck out on independent lines. The most northern of the group is Kāshmīrī, the language of the State of Kashmīr. Tradition informs us that this country was originally inhabited by Piśāchas, who must have spoken a tongue allied to Shīnā; but at an early period it suffered an

invasion from the south, and was colonized by folk from the Punjab. The modern language fully bears this out. Although at the bottom we find a layer of Shīnā words[1] and idioms, this is almost entirely hidden by an overlayer of a second language, closely allied to the Lahndā of the Western Punjab. Owing to the large number of broken vowels which it possesses, and to the changes which they undergo through the influence of others which follow them but are themselves silent, Kāshmīrī is almost as difficult for a foreigner to pronounce as is English. It has an old literature of considerable extent, but the modern language has borrowed so freely from Persian and Arabic that the books written two or three centuries ago are hardly intelligible to natives at the present day. The bulk of the population is now Muhammadan, only a few Pandits preserving the memory of the ancient language. Kāshmīrī has two or three dialects, of which the most important is Kishtwāṛī.

Kohistānī is the old language of the Indus and Swāt Kohistāns. It is now nearly superseded by Pashto, only a few tribes still employing it. Each of these has its own dialect. The country has not been thoroughly explored, and very little is known about these forms of speech. Like Kāshmīrī, they have a Shīnā basis, covered by an overlayer from the Western Punjab. Kohistānī.

Lahndā or Western Panjābī is a language which appears under many names, such as Poṭhwāṛī, Chibhālī, Jaṭkī, Mūltānī, or Hindko. None of these names is suitable, as each indicates only the dialect of some special tribe or of some special locality. 'Lahndā,' i.e. 'Western,' has been lately suggested, and has been tentatively adopted, although it, too, is far from satisfactory. The name 'Western Panjābī' suffers from the disadvantage of suggesting a connexion which does not exist with Panjābī proper. Lahndā is spoken in the Western Punjab as far east as, say, the seventy-fourth degree of east longitude. It once extended much farther to the east, but has there been superseded by the Midland language, from which the modern Panjābī has sprung. There is no definite boundary between these two languages. As explained under the head of the latter, they merge into each other very gradually. If we take the conventional boundary line just suggested, we shall find plenty of Lahndā characteristics to its east, gradually diminishing as we proceed, and at the same time many traces of Panjābī for a considerable distance to its west. The population is mixed, and has been mixed for centuries. The Sanskrit Lahndā.

[1] The commonest words, such as those for 'father,' 'mother,' &c., are Shīnā, not Indian, at the present day.

writers had a very poor opinion of the Central and Western Punjab, although these tracts were not far from the holy Saraswatī. The inhabitants are described as possessing no Brāhmans, living in petty villages, and governed by princes who supported themselves by internecine war. The population was casteless, had no respect for the Vedas, and offered no sacrifices to the gods. They were flesh-eaters (a Piśācha characteristic) and hard drinkers, and their women were charged with polyandry like the Jats of the present day.

West of the Indus, up to the Afghān border, Lahndā under various names is spoken by Hindus, while the Pathān Musalmāns speak Pashto. Lahndā has two main dialects, one spoken north and the other south of the Salt Range. It has no literature. Its written character is, properly, the Laṇḍā also employed for Panjābī, but this has been nearly superseded by a modification of the Persian.

Sindhī. Sindhī is the language of Sind and the neighbourhood. It is closely connected with Lahndā, and, owing to its isolated position, it preserves many phonetic and flexional peculiarities which have disappeared elsewhere. There was, in former days, a Piśācha colony in Sind, and traces of their language are still to be found in Sindhī, which is, in other respects, a typical speech of the Outer Band of languages. It has no literature to speak of, and has received little cultivation of any kind. The population which employs it being largely Musalmān, its vocabulary borrows freely from Persian; and, since the country has come under British rule, an adaptation of the Persian character has been employed for writing it, although Laṇḍā is also used for personal memoranda and accounts. Sindhī has four main dialects—Siraikī, spoken in Upper Sind; Lāṛī (the standard dialect) in Lāṛū or Lower Sind; Tharelī in the Thar or Desert; and Kachchhī in Cutch. The first approaches Lahndā, while Tharelī represents Sindhī merging into Mārwāṛī. Kachchhī is a mixture of Sindhī and Gujarātī, in which the former predominates.

Marāṭhī. South of Sindhī the Outer Band of Indo-Aryan vernaculars is interrupted by Gujarātī, the Intermediate language which has reached the seaboard. South of Gujarātī, extending from near Damān along the coast of the Arabian Sea to beyond Goa, we come to the great daughter of Māhārāshṭrī Prākrit, the southern Indo-Aryan language, Marāṭhī. The Saurāshṭrī dialect of Māhārāshṭrī once covered Gujarāt, but has been superseded by the Midland language. We find, however, traces of Saurāshṭrī not only in Gujarātī, but probably also right down the coast as

far as the modern Marāṭhī extends. In the Bombay Presidency Marāṭhī covers the north of the Deccan plateau and the strip of country between the Ghāts and the Arabian Sea. It is also the language of Berār and of a good portion of the north-west of the Nizam's Dominions. It stretches across the south of the Central Provinces (except a small portion of the extreme south, in which Telugu is the language), and, in a very corrupt form, occupies most of the State of Bastar. Here it merges into Oṛiyā through the Bhatrī dialect of that language. It has to its north, in order from west to east, Gujarātī, Rājasthānī, Western Hindī, and Eastern Hindī. The first three are connected with the Midland, and Marāṭhī does not merge into them. On the contrary, there is a sharp border-line between the two forms of speech. In the east it shows several points of agreement with the neighbouring Chhattīsgaṛhī dialect of Eastern Hindī, and it shades off gradually into Oṛiyā, both these languages being based on Prākrits of the Outer Band. Oṛiyā is its near neighbour to the east. On the south lie Dravidian languages, and it is bounded on the west by the Arabian Sea. In Marāṭhī we first meet in general use a past participle, and its resulting past tense, of which the characteristic is the letter *l*. This extends through all the remaining languages of the Outer Band—Oṛiyā, Bengali, Bihārī, and Assamese. It is also found, in restricted use, in Gujarātī, alongside of the Midland form without the *l*, and is there one of the relics of the old Saurāshṭrī Prākrit. This *l*-participle, therefore, not only covers the whole of Aryan East India, but reaches, through an almost unbroken chain of dialects all imperceptibly shading off into each other, to the Arabian Sea. This illustrates the intimate relationship which exists among all these forms of speech; and although Assamese is widely different from Marāṭhī, and although a speaker of the one would be entirely unintelligible to a speaker of the other, a man could almost walk for 1,500 miles, from Dibrugarh to Goa, without being able to point (except, perhaps, in Bastar) to a single stage where he had passed from one language to another.

Marāṭhī has a copious literature of great popularity. The poets wrote in the true vernacular of the country, and employed a vocabulary mostly composed of honest *tadbhavas*. The result is that the language at the present day is rich in them; and though the scholars for whom the Marāṭhā country is famous have in later times striven with some success to heighten the style of the language by the use of *tatsamas*, these parasites have not obtained the complete mastery over the

literary form of speech that they have in Bengal. The country was not invaded by the Musalmāns till a comparatively late period, and was ultimately successful in repelling the invasion, so that the number of words borrowed from and through Persian is small. As Mr. Beames says, Marāṭhī is one of those languages which may be called playful. It delights in all sorts of jingling formations, and has struck out a larger quantity of secondary and tertiary words, diminutives and the like, than any of the cognate languages.

Standard Marāṭhī is printed in the Deva-nāgarī character, but for purposes of writing a current hand, known as *mōḍī* or 'twisted,' is in common use. It has three main dialects. The standard dialect, commonly called 'Deśī Marāṭhī,' is spoken in its greatest purity in the country round Poona. Sub-dialects of it are also found in the Northern and Central Konkan. In the Southern Konkan there is a distinct dialect known as 'Konkaṇī.' It differs so widely from standard Marāṭhī that some of its speakers claim for it the dignity of a separate language. To its south and west the Dravidian Kanarese is spoken, so that the Kanarese alphabet is generally employed for recording Konkaṇī. Natives also employ the Deva-nāgarī character for the same purpose, while the Portuguese missionaries of Goa have introduced the use of the Roman character among their converts. The Marāṭhī of Berār and of the Central Provinces is the third dialect. It agrees more closely with the standard of Poona, the main differences being those of pronunciation. To these forms of speech may be added Halbī, which, however, can hardly be called a true dialect. It is spoken in the State of Bastar and the neighbourhood by Dravidian tribes who have attempted to abandon their aboriginal tongues. It is a mechanical mixture of bad Marāṭhī, bad Oṛiyā, and bad Chhattīsgaṛhī, which varies in the proportions of its constituents from place to place. On the whole, Marāṭhī inflexions form its most prominent feature.

We now come to those languages of the Outer Band which are directly derived from the ancient Māgadhī Prākrit. They form the Eastern group of Indo-Aryan vernaculars, and are Bihārī, Oṛiyā, Bengali, and Assamese. Of these the first-named occupies the original home of the common parent, from which colonies have issued in three directions, to the south, the south-east, and the east, where each developed on its own lines into one of the other three.

Bihārī. Magadha, the land where the Buddha first preached, and in which the famous Asoka had his capital city, corresponds to

what we now call the Districts of Patna and Gayā. To its north, across the Ganges, lies the land of Tirhut, known in ancient times as Mithilā. To its west lies the Bhojpur country, comprising the west of modern Bihār and the east of the United Provinces. It may be taken as extending to the degree of longitude passing a few miles west of the city of Benares. To the south of Magadha lie the two plateaux of Chotā Nāgpur, the northern coinciding with the District of Hazāribāgh, and the southern with that of Rānchī. To its east lies Bengal proper. With the exception of Bengal, all these tracts together form the home of the present Bihārī language. It has three dialects, Maithilī, Magahī, and Bhojpurī, the last of which differs considerably from the two others. Maithilī, which is spoken in Tirhut, has a most complicated grammatical system, its verb changing its form, not only with regard to the subject, but also with regard to the object. It has a small literature dating from the fifteenth century, and, when written by Brāhmans, has a character of its own akin to that employed for Bengali. The people who speak it are among the most conservative in India, and rarely emigrate from their overcrowded fields to other parts of the country. Their character is reflected in their language, which abounds in archaic expressions. The original Aryan language of Nepāl before the Rājput invasion was an old form of Maithilī. Magahī, the language of the ancient Magadha, or South Bihār, is also spoken in the northern or Hazāribāgh plateau of Chotā Nāgpur, immediately to its south. It resembles Maithilī in the complexity of its verbal conjugation and in general character; but, owing to the long Musalmān domination of this part of India, it is as a rule more flexible and less conservative. The language of Magadha is looked upon by the inhabitants of other parts of India as typically boorish. Although directly descended from the language in which Buddhism was first preached, it has no literature and no traditions, and its speakers are as a whole poor and uneducated.

Far different is Bhojpurī. This dialect is spoken in the east of the United Provinces and in West Bihār. It has also spread to the southern, or Rānchī, plateau of Chotā Nāgpur, where, under a slightly altered form, it is called Nagpuriā. The Bhojpurī of the United Provinces differs somewhat from that of Bihār; but over the whole area the dialect has the same characteristics, being a flexible form of speech, adapted for current use, easy to learn, and not overencumbered by grammatical subtilties. Here again the language reflects the

national peculiarities. The Bhojpurīs are as free from conservatism as the people of Tirhut are the reverse. They wander all over Northern India, and there is hardly a considerable town in which they do not possess a colony.

Apart from the peculiar character employed by the Tirhutiā Brāhmans, all the dialects of Bihārī are generally written in the current form of Deva-nāgarī known as 'Kaithī.'

Oṛiyā.

Oṛiyā is the language of Orissa and of the adjoining parts of Madras and the Central Provinces. It is spoken in an isolated part of India, has been but slightly affected by contact with other languages, and has changed little since the fourteenth century, at which period we find it in use in inscriptions. It has a considerable literature of some merit, and was formerly written by indenting marks with a stylus upon leaves of the talipot palm. On such a surface a straight indented line along the grain tends to cause a split; and this accounts for the characteristic of its peculiar alphabet, in which the long line familiar to readers of Deva-nāgarī is replaced by a series of curves.

Oṛiyā is a musical language, with a grammar which is simple but complete. It borrows very freely from Sanskrit, and the chief defect of its literary style is this overloading with *tatsamas*.

Bengali.

In its own home Bengaḷi has a greater number of speakers than any other Indian language. In 1901, out of the forty-four and a half millions who returned this language as their vernacular, forty-four and a quarter millions inhabited the territories then subject to the Lieutenant-Governor of Bengal (with the connected States) and the Bengali Districts of Assam. The remaining quarter million were scattered throughout India, mainly finding employment as clerks or the like. Over the huge area in which it is a vernacular, Bengali is by no means uniform. Its main dialectal division is not, however, according to locality, but lies between the literary and the spoken language. If we except the language employed by the Musalmān inhabitants of the eastern part of the Gangetic delta, the literary dialect is the same over the whole country. This is never used when speaking, except in formal addresses and the like. Even the most highly educated natives employ the colloquial dialect in their ordinary conversation. The literary form of the language differs from the colloquial not only in its highly Sanskritized vocabulary but in its grammar, in which the dead forms of three centuries ago are retained in a state of fictitious animation. This literary style dates from the revival of learning which took place in Calcutta, under English influences, at the commencement of the last century. Up to that time Bengal

had an indigenous poetical literature of its own, written in a purified form of the spoken vernacular. With the advent of the English there arose a demand for prose literature, and the task of supplying it fell into the hands of Sanskrit-ridden pandits. Anything more monstrous than this prose dialect, as it existed in the first half of the nineteenth century, it is difficult to conceive. Books were written, excellent in their subjects, eloquent in their thoughts, but in a language from which something like ninety per cent.[1] of the genuine Bengali vocabulary was excluded, and its place supplied by words borrowed from Sanskrit which the writers themselves could not pronounce. During the past fifty years there has been a movement, without much success, to reduce this absurd Sanskritization; but, still, at the present day many words current in literary Bengali are mere ideograms. The Bengali vocal organs are not adapted to the pronunciation of Sanskrit words, and so these words spell one thing, and, when read aloud, sound something quite different. Under such circumstances literary Bengali is divorced from the comprehension of every native to whom it has not been specially taught. It is this which is the official language of Government and of missionaries, and which (with few exceptions) is taught in the grammars written for European students. Bengalis themselves call their Sanskritized book-language 'sādhu-bhāshā,' i.e. the 'excellent speech'; but the adjective which they apply to anything approaching their true vernacular is the significant one of 'sweet.' It is this 'sweet' language which every one with a pen in his hand, be he European or native, endeavours to ignore. It is an instance of history repeating itself. In the old days the classical language was called *sanskrit*, 'purified,' but the epithet applied to the true vernacular Prākrit was *amia*, or 'nectar.'

The many dialects of spoken Bengali fall into three groups: the western or standard, the eastern, and the northern. Western Bengali is spoken in the country on both sides of the Hooghly and to the west. The centre of Eastern Bengali may be taken as the city of Dacca. It extends to the east into the Districts of Sylhet and Cāchār, and, southwards, to beyond Chittagong. The Bengali of Chittagong is very corrupt, and is quite unintelligible to an untravelled native of Calcutta. Farther inland, in the Chittagong Hill Tracts, there is a still more debased dialect called Chākmā, which is written in an alphabet akin to that of Burmese. Northern Bengali is

[1] This estimate is based on actual counting.

spoken north of the Ganges and at the lower end of the Assam valley. It is a dialect which, though closely connected with standard Bengali, really owes nothing to it. It is, by derivation, an intermediate speech between Bihārī and Assamese. In some respects it agrees with Oṛiyā rather than with the language of Calcutta.

Bengali and Assamese are written in very nearly the same alphabet, which is related to that employed by the Brāhmans of Tirhut. It is of the same stock as Deva-nāgarī, but has existed as an independent script since at least the eleventh century A. D.

Assamese. The origin of Assamese has been described above. It is the language of the middle and upper parts of the Assam valley. It is more nearly related to colloquial than to literary Bengali; and its claim to be considered as an independent form of speech, and not as a dialect of that language, depends mainly upon the fact that it possesses an important literature. It has also several well-marked peculiarities of pronunciation. The literary style is happily free from the Sanskritisms which deface that of Bengali. The literature itself is of ancient date and is varied in its character, being particularly rich in historical works. Assamese has no real dialects, though it varies slightly from place to place. Māyāng, one of the languages spoken in the polyglot State of Manipur, may, however, be classed as a dialect of this language.

Dravidian languages. The Dravidian race is widely spread over India, but all the members of it do not speak Dravidian languages. In the north many of them have become completely Aryanized, and have adopted the language of their conquerors while they have retained their ethnic characteristics. Besides these, Dravidians are almost the only speakers of two other important families of speech, the Muṇḍā and the Dravidian proper. Owing to the fact that these languages are nearly all spoken by persons possessing the same physical type, many scholars have suggested a connexion between the two groups of speech, but a detailed inquiry carried out by the Linguistic Survey of India has shown that there is no foundation for such a theory. Whether we consider the phonetic systems, the methods of inflexion, or the vocabularies, the Dravidian have no connexion with the Muṇḍā languages. They differ in their pronunciation, in their modes of indicating gender, in their declensions of nouns, in their method of indicating the relationship of a verb to its objects, in their numeral systems, in their principles of

conjugation, in their methods of indicating the negative, and in their vocabularies. The few points in which they agree are points which are common to many languages scattered all over the world.

Leaving, therefore, the fact of the Dravidian *race* speaking two different families of languages to be discussed by ethnologists, we proceed to consider those forms of speech which are called 'Dravidian' by philologists. Most of these are spoken in Southern India or in the hills of Central India. Two of them have found their way into Chotā Nāgpur and the Santāl Parganas, where they exist side by side with Muṇḍā dialects; and one, Brāhūī, has its home far to the north-west, in Baluchistān. The last was not known to Sanskrit writers, who were familiar with two great languages spoken in their time all over Southern India: namely, the *Andhra-bhāshā* and the *Drāviḍa-bhāshā*, the former corresponding to the modern Telugu, and the latter to the rest. This old division agrees with the classification of the modern vernaculars, which is as follows:—

	Number of speakers (1901).
A. Drāviḍa group:	
Tamiḷ	16,525,500
Malayāḷam	6,029,304
Kanarese	10,365,047
Koḍagu	39,191
Tuḷu	535,210
Toda	805
Kota	1,300
Kurukh	592,351
Malto	60,777
B. Intermediate languages:	
Gonḍ, &c.	1,123,974
C. Andhra group:	
Telugu	20,696,872
Kandh	494,099
Kolāmī	1,505
D. Brāhūī	48,589
Total	56,514,524

The following general account of the main characteristics of the Dravidian forms of speech is taken, with one or two verbal alterations and omissions, from the *Manual of the Administration of the Madras Presidency*:—

'In the Dravidian languages all nouns denoting inanimate substances and irrational beings are of the neuter gender. The distinction of male and female appears only in the pronoun of the third person, in adjectives formed by suffixing the pronominal terminations, and in the third person of the

verb. In all other cases the distinction of gender is marked by separate words signifying "male" and "female." Dravidian nouns are inflected, not by means of case terminations, but by means of suffixed postpositions and separable particles. Dravidian neuter nouns are rarely pluralized. Dravidian languages use postpositions instead of prepositions. Dravidian adjectives are incapable of declension. It is characteristic of these languages, in contradistinction to Indo-European, that, wherever practicable, they use as adjectives the relative participles of verbs, in preference to nouns of quality or adjectives properly so called. A peculiarity of the Dravidian (and also of the Muṇḍā) dialects is the existence of two pronouns of the first person plural, one inclusive of the person addressed, the other exclusive. The Dravidian languages have no passive voice, this being expressed by verbs signifying 'to suffer," &c. The Dravidian languages, unlike the Indo-European, prefer the use of continuative participles to conjunctions. The Dravidian verbal system possesses a negative as well as an affirmative voice. It is a marked peculiarity of the Dravidian languages that they make use of relative participial nouns instead of phrases introduced by relative pronouns. These participles are formed from the various participles of the verb by the addition of a formative suffix. Thus, "the person who came" is in Tamiḷ literally "the who-came."'

Tamiḷ.

Tamiḷ, or Arava, covers the whole of Southern India up to Mysore and the Ghāts on the west, and reaches northwards as far as the town of Madras and beyond on the east. It is also the vernacular of the northern part of Ceylon[1], and has been widely spread over Further India by emigrant coolies. As domestic servants its speakers are found all over India. It is the oldest, richest, and most highly organized of the Dravidian languages: plentiful in vocabulary, and cultivated from a remote period. It has a copious literature, which is couched in a somewhat artificial dialect known as 'Shen' (i.e. 'perfect'), in contrast with the colloquial form of speech, which is called 'Kodum' or 'Codoon' (i.e. 'rude'). Only a few insignificant dialects of the spoken language have been recorded. The name 'Tamiḷ' and the word 'Drāviḍa' are both corruptions of the same original, 'Drāmiḍa.' The language has an alphabet of its own.

Malayāḷam.

Malayāḷam is a modern offshoot from Tamiḷ, dating from the ninth century A.D. It is the language of the Malabar coast, and has one dialect, Yerava, spoken in Coorg. Its most noteworthy features are that, except among certain tribes, it has dropped all the personal terminations of verbs, and that the words which it has borrowed from Sanskrit are particularly numerous. It has a large literature, and employs the old Grantha character used in Southern India for Sanskrit writings.

Kanarese.

Kanarese is the language of Mysore and of the neighbouring

[1] In 1901 the number of Tamiḷs in Ceylon was 953,535.

portion of the Ghāt country, including the southern corner of the Bombay Presidency. It, also, has an ancient literature, written in an alphabet closely connected with that employed for Telugu. It has two petty dialects, Badaga and Kurumba, both of which are spoken in the Nīlgiris. Koḍagu, the language of Coorg, is also considered by some to be a dialect of Kanarese. It lies midway between it and Tuḷu, the language of a portion of the South Kanara District of Madras. Toda and Kota are petty forms of speech spoken by small tribes on the Nīlgiris.

Koḍagu.

Tuḷu.

Toda, Kota.

Kuruḵẖ, or Orāoñ, is the vernacular of a Dravidian tribe in Chotā Nāgpur and the adjoining portions of the Central Provinces. It is more closely connected with ancient Tamiḻ and with ancient Kanarese than with any other of the great Dravidian languages. The people themselves say that they and the Maler actually did come to their present seats from the Kanara country. Malto is the language of these Maler, a tribe nearly related to the Orāoñs, and now settled, still farther north, near Rājmahāl on the bank of the Ganges. Neither of these two languages has any literature or any alphabet. The Roman alphabet is usually employed for recording them.

Kuruḵẖ.

Malto.

The Goṇḍ language is spoken in the hill country of Central India. Many of the Goṇḍs have abandoned their own dialects and have taken to Aryan forms of speech. The true Goṇḍ is intermediate between the Drāviḍa and Andhra tongues, and has numerous dialects. It is unwritten, and has no literature.

Goṇḍ.

Telugu is the only important Andhra language. It is the principal form of speech in the eastern part of the Indian Peninsula, from the town of Madras to near Orissa. It is also spoken in the east of the Nizam's dominions and in the extreme south of the Central Provinces, extending into Berār. It has an extensive literature, written in a character of its own, akin to Deva-nāgarī, which, like Oṛiyā, owes its numerous curves to the fact that it has been written on palm-leaves.

Telugu.

Kandh, or Kuī, is spoken by the Khonds of the Orissa Hills. It, like Kolāmī and other petty dialects of distant Berār, is quite uncultivated.

Kandh.

Kolāmī.

Brāhūī, also an uncultivated language, is heard in the central highlands of Baluchistān. Owing to its isolated position, it has developed on lines of its own; but, although its speakers show none of the Dravidian ethnic characteristics, it is undoubtedly a Dravidian language. Ethnologists differ as to whether the speakers of Dravidian languages entered India from the north-west, or from the hypothetical Lemurian continent, now under the Indian Ocean, in the south. If they

Brāhūī.

came from the north-west, we must look upon the Brāhūīs as the rear-guard; but if from the south, they must be considered as the advance-guard of the Dravidian immigration. Under any circumstances it is possible that the Brāhūīs alone retain the true Dravidian ethnic type, which has been lost in India proper by admixture with other aboriginal nationalities such as the Muṇḍās. This is suggested by the linguistic circumstances, and is worthy of investigation.

The Muṇḍā languages.

The Muṇḍā languages are often called 'Kolarian,' a name which is founded on a false theory, and which is, moreover, misleading. The name 'Muṇḍā' was first given to this family of speech by the late Professor Max Müller long before 'Kolarian' was invented. These languages are among those which have been longest spoken in India, and may, with great probability, claim to be aboriginal. It is of importance to note that there exists a common element in them, on the one hand; and in the Mon-Khmer languages of Further India, in the dialects of certain wild tribes of Malacca and Australonesia, and in Nicobarese, on the other, although the two sets of speech are not otherwise connected. This is best explained by the supposition that a common language was once spoken over both Further India and a great part of India proper, and that in the latter it is represented at the present day by the Muṇḍā languages, while in Further India, Malacca, Australonesia, and the Nicobars[1] it was overwhelmed by an invasion of other languages (much as was the case with the original Piśācha language of Kashmīr), and there now shows only sporadic, though convincing, traces of its former general use.

The Muṇḍā languages are agglutinative, and preserve this characteristic in a very complete manner. Suffix is piled upon suffix, and helped out by infix, till we obtain words which have the meaning of a whole sentence. For instance, the word *dal* means 'strike,' and from it we form the word *da-pa-l-ocho-akan-tahen-tae-tiñ-a-e*, which signifies 'he, who belongs to him who belongs to me, will continue letting himself be caused to fight.' Not only *may* we, but we *must* employ this posy of speech, if, for instance, my slave's son was too often getting himself entangled in affrays. As compared with Dravidian languages, Muṇḍā languages have a series of semi-consonants which correspond to the so-called 'abrupt' tone of the languages of Further

[1] Endeavours have also been made to carry this old language still farther, and to show a connexion between the Muṇḍā languages and those of Australia itself. This interesting question is still under discussion.

India. The distinction of gender is between animate and inanimate nouns, and not between rational and irrational ones. The noun has three numbers—a singular, a dual, and a plural; and the cases of the direct and indirect object are indicated by suffixes added to the verb, while the noun remains unchanged. The numerals are counted by twenties and not by tens. As in Dravidian, the pronoun of the first person plural has two forms, one including, and the other excluding, the person addressed, but in other respects the pronouns are altogether different. There is no agreement whatever between the conjugations of the Muṇḍā and of the Dravidian verb. The latter is simple, while the former exhibits an almost bewildering maze of participial forms, which in every case are converted into tenses by the addition of the letter *a*. Finally, the Muṇḍā languages do not possess anything corresponding to the Dravidian system of negative conjugation.

The principal home of the Muṇḍā languages (the *race* is much more widely spread) is Chotā Nāgpur. Speakers are further found in the adjoining Districts of Bengal, Orissa, Madras, and the Central Provinces, with an outlying colony far to the west in the Mahādeo hills north of Berār. The following is a list of these forms of speech:—

	Number of speakers (1901).
Kherwārī	2,784,395
Kūrkū	87,675
Khaṛiā	101,986
Juāng	10,853
Savara	157,136
Gadaba	37,230
Total	3,179,275

Of these, Kherwārī is much the most important. It has several dialects, which are often wrongly considered to be distinct languages. They are Santālī or Hâr, Muṇḍārī, Bhumij, Birhâr, Kōḍā, Ho, Tūrī, Asurī, Agariā, and Korwā. Of these, Santālī and Muṇḍārī have received much attention from scholars, and we have excellent grammars of them, as well as a dictionary of the former. Ho is the dialect of the Laṛkā, or 'fighting,' Kols of Singhbhūm, while the others are spoken by petty forest tribes. The home of Santālī is the Santāl Parganas, but it is also found much farther south, down the western border of Bengal proper into Northern Orissa. The rest are all spoken in Chotā Nāgpur and in the neighbouring hill tracts of Orissa and the Central Provinces. Kherwārī.

Kūrkū.

Kūrkū is the Muṇḍā language of the Mahādeo Hills. With Khaṛiā and Juāng it forms a linguistic sub-group, but is more nearly related to Kherwārī than are the other two. It, also, has received some study, and we have an excellent grammar of it. Khaṛiā is found in the south-west corner of Rānchī and in the adjoining States of Jashpur and Gāngpur. The tribe extends much farther south, but they have as a rule exchanged their own language either for the Dravidian Kurukh or for some broken Aryan patois. The language is dying out, and is nowhere spoken in its original purity. It has borrowed freely from neighbouring forms of speech, and has been compared to a palimpsest, the original writing of which can only be deciphered with some difficulty. Juāng resembles Khaṛiā. It is the language of a small wild tribe in the Orissa Hills. From the leaf-garments of its speakers it is sometimes called 'Patuā.' Savara and Gadaba are two languages spoken in Madras territory close to the Orissa border. Very little is known concerning them; but it is plain that they are much mixed with the Telugu spoken round about them, and they may probably be grouped as akin to Khaṛiā and Juāng. The Savaras are an ancient and widely spread tribe, who were known to the Indo-Aryans in Vedic times, and are mentioned by Pliny and Ptolemy. Only a few of them still adhere to their own language.

Khaṛiā. Juāng. Savara, Gadaba.

None of the Muṇḍā languages have any proper written character or any literature. The Roman character is generally employed for recording them.

The Indo-Chinese languages.

The languages of Further India, together with those spoken in Tibet, are usually grouped under the general name of 'Indo-Chinese[1],' which includes two distinct families, the Mon-Khmer and the Tibeto-Chinese. The original home of all these people seems to have been North-western China, between the upper courses of the Yang-tse-kiang and the Ho-ang-ho, and from here they spread out in all directions. So far as British India is concerned, they followed river valleys in their migrations, down the Chindwin, the Irrawaddy, and the Salween into Burma, down the Brahmaputra into Assam, and up the Brahmaputra into Tibet. From Tibet they occupied the Himālayas, and are now found in Nepāl and in other mountainous tracts lying south of the main watershed. Three successive waves of completed migration can be traced. First, there was,

[1] A complete list of the Indo-Chinese and remaining languages dealt with is given in Appendix I, pp. 390-4.

in prehistoric times, a Mon-Khmer invasion into Further India and Assam. Secondly, there was the first Tibeto-Chinese invasion, that of the Tibeto-Burmans, into the same localities and into Tibet, the period of which is also unknown. Thirdly, there was the second Tibeto-Chinese invasion, that of the Tai branch of the Siamese-Chinese into Eastern Burma, which took place in force about the sixth century A. D. Finally, another Tibeto-Burman invasion, that of the Kachins, was actually in progress when it was stopped by the British conquest of Upper Burma. The later invaders drove the first to the seaboard or into the hills overlooking the river valleys ; and thus we find the earliest immigrants to India, the Mon-Khmers, confined at the present day to the coast country of Pegu and a few mountain tracts in Assam and Burma, while the Tais, who found most room for expansion in the direction of Siam, have driven the Mon-Khmers of that country to the sea-coast also.

All the Indo-Chinese languages are monosyllabic. Each word consists of one syllable, and refuses to be classed under any of the well-known categories of noun, verb, and particle. It expresses an indefinite idea, which may be employed to connote any part of speech, according to its position in the sentence and its relation to its neighbours. The words being monosyllables, the necessary paucity of different sounds is eked out by tones, each sound being raised or lowered in pitch, shortened or prolonged, according to the idea which it is intended to convey. For instance, the Shan monosyllable *kau* means 'I,' 'be old,' 'nine,' 'a lock of hair,' 'indifference to an evil spirit,' 'an owl,' 'a *butea*-tree,' 'complaining of any thing,' 'the shin,' 'the balsam plant,' or 'a mill,' according to the tone with which it is pronounced. The number of tones differs in various languages. Shan has fifteen, while Western Tibetan is said to have only one. The most characteristic of these languages, Chinese and Siamese, belong to what is known as the isolating class—i.e. every monosyllable has a distinct definite meaning of its own, and complex ideas are expressed by compounding two or more together. For instance, 'he went' would be indicated by three words, one meaning 'he,' another connoting the idea of 'going,' and a third connoting the idea of 'completion.' Others belong to what is known as the agglutinating class, in which certain words are now only used as suffixes to indicate relationship of time or space, and cannot be employed independently with meanings of their own. It is as if the word 'completion' in 'he-going-completion' had lost

its original meaning, and was now only used as a sign to indicate that the idea connoted by some other word performing the function of a verb was also the idea of a completed action.

The Mon-Khmer languages.

We have already mentioned the fact that the Mon-Khmer languages agree with some Malacca dialects and with Nicobarese in having at their base another non-related language which is connected with Muṇḍā forms of speech, and which must have been the aboriginal language of those tracts of Further India which were conquered by the Mon-Khmers. The Mon-Khmer languages are numerous in Indo-China. In British India they are only four in number. The most important is Khāsi, spoken in the hill country south of the Central Assam valley, where it has survived as an island amid a sea of Tibeto-Burman speech. It has been given a literature by the missionaries who work among its speakers; and this language, which a century ago was rude, uncultured, and unwritten, is now one of the Indian vernaculars recognized in the examination halls of the Calcutta University. It is written in the Roman character and has 177,827 speakers. The other important language is the Mon or Talaing of Pegu and the coast districts round the Gulf of Martaban (174,510 speakers). Palaung (67,756) and Wa (7,667) are two smaller dialects spoken in the eastern hills of Upper Burma.

Khāsi.

The Tibeto-Burman languages. Bhoṭiā, Tibetan.

The Tibeto-Burman branch of the Tibeto-Chinese languages is very widely spread. It includes two great languages, Tibetan and Burmese, each of which has an alphabet of its own akin to Deva-nāgarī, as well as an extensive literature. Tibetan is one of several dialects grouped under the general name of 'Bhoṭiā,' from Bhoṭ, the Indian name of Tibet. Besides the Bhoṭiā of Tibet or Tibetan, there are the Bhoṭiā of Bāltistān or Bāltī, that of Ladākh or Ladākhī, that of Sikkim or Denjong-ke, that of Bhutān or Lho-ke, and so on. Connected with Bhoṭiā, but not dialects of it, are a number of Himālayan languages of which the most noteworthy are Newārī (the main language of Newār, i.e. Nepāl), Rong or Lepcha (of Sikkim), Mangar, and Murmī. Most of these are really Nepāl languages, whose speakers (many of them soldiers in our Gurkha regiments) are temporary visitors to British India. This group is called the 'Non-pronominalized Himālayan languages,' to distinguish it from another, of which Kanāwarī, Limbū, and the so-called Kirāntī forms of speech are the most important members, and which Hodgson classed as the 'Pronominalized Himālayan languages.' Although this latter group is in the main Tibeto-Burman in character, it also shows manifest traces

Pronominalized languages.

of an older substratum having striking points of resemblance to the Muṇḍā tongues. There are the same distinctions between things animate and inanimate, the same system of counting in twenties, the same occurrence of a dual number, and of a double set of plural forms for the first personal pronoun, and the same tendency to conjugate a verb by means of pronominal suffixes. All this cannot be mere coincidence. It inevitably leads to the conclusion that these Himālayan tracts were once inhabited by tribes speaking a language connected with those now in use among the Muṇḍās, who have left their stamp on the dialects spoken at the present day. We have already seen how a Muṇḍā basis also exists in the Mon-Khmer languages, which has been traced into Malacca, Australonesia, and even Australia; and this line of Himālayan dialects offers an important clue to ethnological inquirers. West of Bhutān we come across another Tibeto-Burman group, spoken by wild tribes of the hills to the north of the Assam valley. These are Aka, Daflā, Abor-Miri, and Mishmi. In the lower Assam valley itself and the country to its south (omitting the Khāsi Hills) we have the Bodo group, spoken by 596,411 people, of which the principal languages are Bårå or Mech, the tongue of scattered tribes in the valley, Gāro of the Gāro Hills, and Tipurā or Mrung of Hill Tippera. Then we have the Nāgā languages of Central and Eastern Assam. The most important of these is Mikir of the Mikir Hills in the valley itself. To the south and south-east there are the Nāgā Hills, inhabited by many fierce tribes whom we are slowly winning to civilization, and each possessing a language of its own. Such are Angāmi, Semā, Āo, Lhotā, and Namsangiā, with fourteen or fifteen others. None of them, of course, has any literature, and of many of them little but the names and a few words are known. The Angāmi Nāgās are those with whom we have fought most, and with whom we are best acquainted. East of Assam, in the confused mountainous country which forms the north of Upper Burma, are a number of cognate dialects grouped together under the general name of Kachin or Singpho. These wild Kachins were migrating into Burma itself, and had already penetrated far into the Shan States, when we annexed that country.

North Assam Sub-branch.

Bodo group.

Nāgā group.

South of the Nāgā Hills lies the State of Manipur, and here we first meet the group of languages known as Kuki-Chin. Meithei, the official language of the State, is the only one of them which possesses an alphabet and a literature. Owing to the existence of the latter its development has been retarded,

Kuki-Chin group.

so that it is in an older stage than the rest. The others are scattered in colonies over Manipur and Cāchār, and extend south, through the hill country, as far as the Sandoway District of Burma. Since they occupied this latter area, there has been a constant tendency to expand northwards. On the west they were barred by the sea, and on the south and east by the stable government of Burma. Thus wave after wave has been driven to the north by those who were behind. The Kuki-Chins of Manipur and Cāchār once occupied the hills immediately to the south, and these are now held by the Lushais, who were originally pushed forward from the south-east and drove them on. This progress has been arrested by our conversion of Cāchār into settled territory. There are more than thirty Kuki-Chin languages, some with several dialects. The most important, both politically and in the numbers that speak them, are Lai in the Chin Hills, and Lushei or Dulien in the Lushai Hills. The Kuki-Chin are the most typical of all the Tibeto-Burman languages. They do not possess a real verb, the conception being expressed with the aid of a verbal noun. When a speaker of Lushei, for instance, wishes to say 'I go,' he says 'my going'; and for 'I went,' 'my going-completion.'

Burmese.

Passing over a number of hybrid dialects we come to Burmese, which is the predominant language, even where others are spoken, all over Upper and Lower Burma, except in the Chin Hills, the Shan States, and the Kachin country north of Bhamo. It, and the related Mrū, are the vernaculars of 7,498,794 people. It has many local dialects, but, with one or two exceptions, these are little known. The most important dialect is Arakanese, which branched off from the main stem at an early date, and has developed on independent lines. Burmese has a considerable literature, of which the poetry is written in a special and difficult dialect; and a written character of its own, derived from the ancient square Pāli, but abounding in curved lines, and connected, through the Pāli, with Devanāgarī. The development of the spoken language has proceeded more rapidly than that of the written language, so that words are nowadays seldom pronounced as they are spelt.

Shan.

The only important Tai language of British India is Shan, spoken in the south-east of Upper Burma, and closely allied to Siamese. A Tai tribe called the Āhoms made themselves masters of Assam in the year 1228 A.D. They were followed by other Shan colonies, which still survive and speak their own dialects. The most important is Khāmtī. Āhom has been

dead for centuries, though its literature still survives and can be interpreted by a few priests of the old religion. The Āhoms were pagans, but the rest of the Shans, like the Burmese, are Buddhists. Shan has a voluminous literature, and a written character based on that of Burmese.

The Karen tribe is principally scattered over Lower Burma, though its members are also found in the Shan Hills. Their language likewise belongs to the Siamese-Chinese branch of the Tibeto-Chinese family. The generally accepted theory regarding this form of speech is that it is connected with Chinese though not descended from it, while the people are pre-Chinese.

Miscellaneous languages.

The remaining vernaculars of India proper are unimportant. The Selungs, a tribe of sea-gipsies inhabiting the Mergui Archipelago, speak a language akin to Malay. Such, also, is Nicobarese, which has, however, like Mon-Khmer, a substratum of Muṇḍā. Some scholars class this as a Mon-Khmer language with Malay corruptions. Two languages have not yet been classed by philologists. These are Andamanese and Burushaski. The former is really a group of languages which are agglutinating, make free use of prefix, infix, and suffix, and are adapted only to the expression of the more simple ideas. Burushaski is spoken in the extreme north-west of India on the borders of Turkistan, by the inhabitants of Hunza-Nagar. No one has hitherto succeeded in tracing a connexion between it and any other known form of speech. It has an elaborate grammar, and its most characteristic feature is the frequent use which is made of pronominal prefixes, so as sometimes to alter greatly the appearance of a word. The country in which it is spoken did not fall within the operations of the Census of 1901, and hence no speakers of it were recorded.

The so-called 'Gipsy' languages have nothing to do with European Romani. They are a number of dialects spoken by wandering tribes, often of very bad reputation. Some are mere thieves' jargons, others are hybrids developed in journeys from place to place, and some are real dialects of well-known languages.

In Aden we find Arabic and Somali spoken. The former belongs to the Semitic and the latter to the Hamitic family. They hardly fall within the lines of the present inquiry.

G. A. GRIERSON.

APPENDIX I

I. List of the Indo-Chinese Languages spoken in British India and Nepal

Family, Branch, and Sub-branch.	Group and Sub-group.	Language.	Total Number of speakers.	Where chiefly spoken in British India.
MON-KHMER FAMILY.	. . .	Mon, Talaing or Peguan.	174,510	Burma.
		Palaung.	67,756	"
		Wa.	7,667	"
		Khāsi.	177,827	Assam.
TIBETO-CHINESE FAMILY. **TIBETO-BURMAN BRANCH.** **Tibeto-Himālayan Sub-branch.**	**Tibetan Group.** (Many of these are not vernaculars of British India.)	Bhoṭiā of Tibet, or Tibetan.	35,818	Punjab States, Punjab, United Provinces, Bengal, and Kashmīr (Census figures corrected. Not vernacular).
		Bhoṭiā of Bāltistān, or Bāltī.	130,678	Kashmīr.
		Bhoṭiā of Ladākh, or Ladākhī.	90	Punjab (not vernacular).
		Sharpā Bhoṭiā.	4,407	Bengal (not vernacular).
		Bhoṭiā of Sikkim, or Denjong-ke.	8,825	Bengal States.
		Bhoṭiā of Bhutān, or Lho-ke.	9,150	Bengal (Census figures corrected. Not vernacular).
		Bhoṭiā (others).	35,822	Kashmīr State.
		Lāhulī.	2,441	Punjab (Census figures corrected).

Family, Branch, and Sub-branch.	Group and Sub-group.	Language.	Total Number of speakers.	Where chiefly spoken in British India.
TIBETO-CHINESE FAMILY (*cont.*). **TIBETO-BURMAN BRANCH** (*cont.*). **Tibeto-Himālayan Sub-branch** (*cont.*).	**Non-pronominalized Himālayan Group.** (Most of the languages of this group really belong to Nepāl. The presence of Padhī, Kāmī, and Mānjhī is accidental. Kāmī and Mānjhī are the names of Nepāl tribes, and it is doubtful if the names also denote languages.)	Gūrung.	7,481	Bengal and Assam.
		Murmī.	32,167	Bengal.
		Sunwār.	5,265	,,
		Mangar.	18,476	Bengal and Assam.
		Newārī.	7,873	Bengal.
		Padhī, Pahrī, or Pahī.	268	Assam.
		Rong or Lepcha.	19,291	Bengal.
		(?) Kāmī.	11	Assam.
		(?) Mānjhī.	902	Bengal.
		Toto.	170	,,
	Pronominalized Himālayan Group. *Eastern Sub-group.* (All the languages of this sub-group really belong to Nepāl. The presence of many of them in British India is accidental.)	Dhīmāl.	611	,,
		Thāmī.	319	,,
		Limbū.	23,200	,,
		Kirāntī languages, viz.		
		Yākhā.	1,366	,,
		Khambū. Jimdār.	43,954	,, These two were classed together in the Census of 1901.
		Bāhing.		Nepāl. No Census figures.
		Bālālī.		,,
		Sāngpāng.		,,
		Lohorong.		,,
		Lambīchhong.		,,
		Wāling.		,,
		Chhingtāng.		,,
		Rūngchhenbūng.		,,
		Dūngmālī.		,,
		Rodong.		,,
		Nāchhereng.		,,
		Kūlung.		,,

Family, Branch, and Sub-branch.	Group and Sub-group.	Language.	Total Number of speakers.	Where chiefly spoken in British India.
TIBETO-CHINESE FAMILY (*cont.*). **TIBETO-BURMAN BRANCH** (*cont.*). **Tibeto-Himālayan Sub-branch** (*cont.*).	**Pronominalized Himālayan Group** (*cont.*). *Eastern Sub-group* (*cont.*).	Thūlung.		Nepāl. No Census figures.
		Chaurasya.		,,
		Khāling.		,,
		Dūmī.		,,
		Unclassed.	64	Assam.
		Vāyū or Hāyū.	114	,,
		Bhrāmū.	15	,,
		Chepang.		Nepāl. No Census figures.
		Kusūndā.		,,
		(?) Thāksyā.		,, Classification doubtful.
	Western Sub-group. (All the languages of this sub-group belong to the Western Himālayas. At the Census of 1901 all but the first were classed under Tibetan. Hence separate figures are not available for all of them. In six cases the estimates of the Linguistic Survey are shown instead.)	Kanāwarī or Multhānī.	19,525	Punjab. Census figures.
		Kanāshī.	980	Punjab. Figures are estimates.
		Manchātī or Paṭnī.	2,441	Punjab. Census figures.
		Rangloī, Gondla, or Tinūn. Chamba Lahulī. Bunān.	7,072	Punjab. Census for the three combined under name of 'Lahulī.'
		Rangkas or Saukiyā Khun.	614	United Provinces. Figures are estimates.
		Dārmiyā.	1,761	,,
		Chaudāngsī.	1,485	,,
		Byāngsī.	1,585	,,
		Janggalī.	200	,,
North-Assam Sub-branch.	. . . .	Aka.	26	Assam.
		Daflā.	805	,,
		Abor-Miri.	40,829	,,
		Mishmi.	71	,,
Assam-Burmese Sub-branch.	**Bodo Group.**	Bāṛā, Mech, or Plains Kachārī.	239,458	Assam and Bengal.

Family, Branch, and Sub-branch.	Group and Sub-group.	Language.	Total Number of speakers.	Where chiefly spoken in British India.
TIBETO-CHINESE FAMILY (*cont.*). **TIBETO-BURMAN BRANCH** (*cont.*). **Assam-Burmese Sub-branch** (*cont.*).	**Bodo Group** (*cont.*).	Lālung.	16,414	Assam.
		Dimā-sā.	19,940	,,
		Chutiā.	2,364	,,
		Gāro.	185,940	Assam and Bengal.
		Rābhā.	20,243	Assam.
		Tipurā or Mrung.	111,974	Bengal and Assam.
		Morān.	78	Assam.
	Nāgā Group. *Nāgā-Bodo Sub-group.*	Mikir.	83,620	,,
		Empeo or Kachchā Nāgā.	6,604	,,
		Kabui.	4	,,
	Western Nāgā Sub-group.	Angāmi.	27,865	,,
		Kezhāmā.	1,546	,,
		Rengmā.	5,617	,,
		Semā.	5,830	,,
	Central Nāgā Sub-group.	Āo.	28,135	,,
		Lhotā or Tsontsü.	16,962	,,
		Thukumi.	26	,,
		Yachumi.	35	,,
	Eastern Nāgā Sub-group.	Tableng.	198	,,
		Tamlu.	1,545	,,
		Mojung.	152	,,
	Nāgā Unclassed.	(Includes Namsangiā and many others.)	69,641	,,
	Kuki-Chin Group. *Meithei Sub-group.*	Manipurī, Meithei, Kathe, or Ponnu.	272,997	Assam and Bengal.
	Old Kuki Sub-group.	Rāng-khol.	4,766	Assam.
		Hallām.	3,693	Bengal.
		Andro.	1	Assam.
		Mhār.	169	,,
		Chaw.	215	Burma.
	Northern Chin Sub-group.	Thādo or Jangshen.	3,399	Assam.
		Sairāng.	71	,,
	Central Chin Sub-group.	Zahao.	3,216	,,
		Lushei or Dulien.	72,142	,,
		Banjogī.	560	Bengal.
		Pankhu.	113	,,
	Southern Chin Sub-group.	Yindu.	43	Burma.
		Khyang.	414	Bengal.
		Khāmi or Khweymi.	25,863	Burma.
		Anu.	775	,,
		That.	67	,,
		Kuki (unspecified).	53,880	Assam and Bengal.

Family, Branch, and Sub-branch.	Group and Sub-group.	Language.	Total Number of speakers.	Where chiefly spoken in British India.
TIBETO-CHINESE FAMILY (*cont.*). **TIBETO-BURMAN BRANCH** (*cont.*). **Assam-Burmese Sub-branch** (*cont.*).	*Unclassed Languages* (*cont.*).	Chin (unspecified).	181,765	Burma.
	Kachin Group.	Kachin or Singpho.	67,340	,,
	Kachin-Burma Hybrids.	Szi Lepai.	756	,,
		Lashi.	84	,,
		Maru.	151	,,
		Maingtha.	465	,,
	Other Hybrids.	. .	56,979	,,
	Burma Group.	Mrū.	23,898	Bengal and Burma.
		Burmese.	7,474,896	Burma and Bengal.
SIAMESE-CHINESE BRANCH.	**Sinitic Group.**	Karen.	887,875	Burma.
	Tai Group.	Siamese.	19,536	,,
		Lü	19,380	,,
		Khün.	42,160	,,
		Shan.	751,772	,,
		Khāmtī.	1,490	,,
		Phākial.	289	Assam.
		Norā.	2	,,
		Tai-rong.	12	,,
		Aiton.	1,569	,,

II. List of Minor Languages spoken in British India

Family, Branch, and Sub-branch.	Group and Sub-group.	Language.	Total Number of speakers.	Where chiefly spoken in British India.
MALAYO-POLYNESIAN FAMILY.	**Malay Group.**	Selung or Selon.	1,318	Burma.
		Nicobarese.	6,513	Nicobars.
SEMITIC FAMILY.	. . .	Arabic.	42,881	Hyderābād and Aden.
HAMITIC FAMILY.	. . .	Somali.	5,530	Aden.
UNCLASSIFIED LANGUAGES.	. . .	Andamanese.	1,882	Andamans.
		Gipsy languages.	344,143	Hyderābād, Berār, Bombay, Central Provinces, and Mysore.
		Burushaski.	. . .	Hunza-Nagar (no Census was taken of this tract).
		Others.	125	

APPENDIX II

Selected Authorities

GENERAL. Nearly all the languages mentioned in this chapter are fully described in the volumes of the Linguistic Survey of India. For each dialect there is a grammar and a selection of specimens. A general account of the languages of India, more full than that contained in the foregoing pages, will be found in chapter vii of the *Report on the Census of India*, 1901.

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CHAPTER VIII

RELIGIONS

Vedic period; c. 1500–200 B.C.

THE literary records of the religions of India begin with the Veda, which is not, as is sometimes supposed, a body of primitive popular poetry, but rather a collection of artificially composed Hymns, the work, in the main, of a priestly class. Its tone generally is ritualistic, the Hymns being intended for use in connexion with the Soma oblation and the fire-sacrifice. In the Veda the powers and phenomena of Nature are invoked as personified gods, or even as impersonal existences. The ritual to which these Hymns were an accompaniment was by no means of a simple type, though much less highly developed than in the succeeding period.

The Aryan religion.

The Indo-Aryans brought little theology with them from their original home beyond the mountain barriers of India. A few gods already in a state of decadence, the worship of ancestors, and some simple rites are all that they possessed in common with their western kinsfolk, among whom their connexion with the Iranians was most intimate, as is shown by the common knowledge of geography and its nomenclature. Recent study of the Indian dialects indicates at least two successive waves of invasion into India—the older, now represented by the speakers of Kāshmīrī, Marāthī, Bengali, and Oriyā; the later by those who use Panjābī, Rājasthānī, Gujarātī, and Western Hindī, who came in like a wedge through the earlier tribes, and settled about the Saraswatī. Dr. Grierson has ingeniously suggested that the contests between these successive bodies of immigrants are represented in the Veda by the struggle of the rival priests, Visvāmitra and Vasishtha, and by the war of the Kauravas and Pāndavas, which forms the subject of the Mahābhārata. This theory would account for much of the varying character of the cults represented in the older sacred literature.

The Vedas.

The Rig-veda, with its supplement, the Sāma-veda, was composed when the Aryans had reached the point of junction of the Punjab rivers with the Indus; the Black and White Yajur-

veda when they had reached the neighbourhood of the Sutlej and Jumna; the Atharvan, combining the lower beliefs of Aryans and aborigines, when the new-comers had penetrated as far as Benares.

Theology, as we find it in the Veda, begins with the worship of the things of heaven, and ends with the worship of the things of earth. We have, first, the worship of the sky gods; then of those that rule the atmosphere; lastly, of those that rule on earth. Under the first class comes the worship of the sun in various forms, as Sūrya, 'the glowing one'; Savitar, 'the enlightener'; Bhaga, 'the giver of blessings'; and Vishnu, who, except in the kindliness of his nature, has little in common with his later form as one of the Hindu triad. In another form as Pūshan, god of agriculture, roads, and cattle, who is also known as Kapardin, 'he of the braided hair,' he forms a link between the Vedic gods and Siva. Dyaus, the shining sky, the Zeus of the Greeks, receives less special worship than might have been expected. In Varuna as the sky god a higher plane is reached. He sits enthroned in the vault of heaven; the sun and stars are the eyes with which he sees all that passes on earth. He, more than any of his brother gods, realizes the conception of personal holiness as an ideal for mankind. Vedic theology.

Among the mid-air gods, Indra gained his ascendancy on Indian soil, where the increasing dependence of an agricultural people on the periodical rains popularized his worship. As a war god he fought in heaven against the demon that dispersed the rain clouds, and was thus adopted by the Kshattriyas to lead them on earth in their campaigns against the aborigines.

Great as are these gods of sky and air, greater still are the earth-born gods: Agni, the fire god, as manifested in the sacrifice, and Soma, the moon-plant (*Sarcostemma viminale*, or *Asclepias acida* of botanists), the worship of which is based on its intoxicating qualities. The latter came to be identified with the moon, a theory still farther developed in the post-Vedic mythology.

With Yama we reach a stage of distinct anthropomorphism. He might have lived for ever, but he chose to die, and was the first to point out to his descendants the way to the other world. To his heaven, guarded by two monstrous dogs, the souls of the departed are conveyed, and are adored on earth as the Pitri, or sainted dead. To retain their place in the abodes of the blessed, the souls need constantly to be refreshed by the pious food-offerings of their descendants. Hence arose the

Srāddha, or periodical feast of the dead, which has had far-reaching effects in the development of the theory of sacrifice.

The gods departmental; Pantheism.

Thus the Vedic gods, like those of Homer, were departmental deities, each nominally invested with a special sphere of action; but their offices were constantly being confounded, and the function of one deity was without hesitation attributed to another. The worshipper, in fact, never cared to determine the relative positions of his gods. Swayed by the impulse of the moment, he invokes now one, now another, to relieve him from danger or to confer a blessing. Hence the beginnings of Indian Pantheism, of which the first literary record is the famous Purusha Hymn of the Rig-veda. But, combined with these pantheistic ideas, there was in Vedic times a groping after one Supreme Being. Even at this time the deepest thinkers began to see dimly that the Ātman, or Spirit, pervaded all things, and that the world and even the gods themselves were but manifestations of it. Thus at the close of the Vedic period philosophers had gained the idea of a Father-god, known as Prajāpati, or Visvakarman, names which in the older Hymns are merely epithets applied to particular gods. This theory was farther developed in the next period, that of the Brāhmanas.

The Brāhmana period; *c.* 800–500 B.C.

A Brāhmana is a digest of the dicta on questions of ritual traditionally ascribed to the earlier teachers, and intended for the guidance of priests. In this period the prevailing tone is in direct contrast to the graceful poetry and naïve speculation of the Vedic singers. The atmosphere is now that of religiosity rather than of religion. The Aryans were by this time permanently settled in Madhya-desa, the 'Middle Land,' or Upper Gangetic valley. This was the birthplace of the special form of faith known as Brāhmanism, which in this connexion means the ritualistic and philosophical development of Vedism. It had its roots in the older Hymns, but it was a new form of faith with a new philosophy added. The old theory of the Ātman was developed, until all forces and phenomena were identified with one Spiritual Being, which when unmanifested and impersonal is the neuter Brahma; when regarded as a Creator, the masculine Brahmā; when manifested in the highest order of men, Brāhmana, the Brāhman Levite class.

The supremacy of the priesthood.

This supremacy of the priestly class had its origin in the Purohita (*praepositus*, 'he that is placed in front'), the family priest, who, as ritual developed, took the place of the house-father, by whom the earlier and simpler worship had been conducted. The priests of the Rig-veda were not as yet

organized into a profession, nor did they claim their office by hereditary right. But the period of the Brāhmanas shows a rapid development of their pretensions. We are told that there are two kinds of gods, the Devas and the Brāhmanas, the latter regarded as deities among men. With this new theology was combined the dogma of the supremacy of sacrifice. 'The sun would not rise,' says the Satapatha Brāhmana, 'if the priest did not make sacrifice.' When we meet it first in the Indian ritual, sacrifice is merely a thank-offering; then it comes to be regarded as a means of nourishing the Pitri, or the gods; finally, a means of wresting favours from them. This naturally resulted in the exaltation of sacrificial ritual. Every religious act must be accompanied by its special Mantra, or formula, each word of which is momentous, each tone fraught with mystery.

Theology and worship in the Brāhmanas.

The writers of this period concern themselves little with theology; what they are interested in is worship. Their gods are much the same as those of the older Hymns, but they extended the pantheon by the admission of allegorical personifications, spirits, demons, and goblins. These, though not specifically referred to in the early Hymns, are not necessarily a new creation. The Atharva-veda is evidence, if evidence be needed, that such beliefs are the stock-in-trade of the hedge-priest among all races at an early stage of culture.

Life after death.

As for eschatology, hell with its torments is well known: 'or else the wicked man will be re-born in some wretched state of being, metempsychosis appearing in this way under the form of an expiation. The good man goes to Svarga, or the community of some god; the sojourn with Yama is not forgotten[1]'; but the fate of the dead is nowhere clearly defined. We read of the weighing in a balance of the dead man's good and evil deeds; or we are told that he has to pass between two raging fires, which consume the evil man and let the good pass by.

Human sacrifice.

One remarkable legend in the Brāhmanas embalms a tradition of human sacrifice. The tale of Harischandra tells how the king was cured of his leprosy by the purchase of Sunahsephas, who was to be offered as a sacrifice to appease the wrath of Varuna. The boy, when led to the stake, prays to the gods for deliverance; they loose him from his bonds and cure the king's disease. It is certain that human sacrifice prevailed among the Indo-Aryans. In a more primitive form it existed until quite recent days among the Khonds and other forest

[1] Barth, E. T., p. 42.

tribes of the Central Indian hills, by whom, like the Mexicans before the conquest and many savage races, the Meriah or victim was solemnly immolated, and fragments of the corpse distributed over the fields to promote the fertility of the crops. Even now, in dark corners of the land, occasional sacrifices of human victims to the goddess Kāli are recorded.

Theology in the Upanishads.

'In the Vedic Hymns,' writes Dr. Hopkins, 'man fears the gods. In the Brāhmanas man subdues the gods, and fears God. In the Upanishads man ignores the gods and becomes God.' But, as the same writer goes on to point out, 'if one took these three strata of thought to be quite independent of each other he would go amiss. Rather, it is true that the Brāhmanas logically continue what the Hymns begin; that the Upanishads logically carry out the thought of the Brāhmanas.' Nor does this statement rightly define the historical order of the theological development, because, though no definite chronology exists, it seems fairly certain that the date of the earliest Upanishad, or exposition of the hidden spiritual doctrine, is not much later than the most modern additions to the Vedic canon. The speculations of the sages of the Brāhmana period were extended in this way: the Ātman, or 'soul' of the Brāhmanas, is now identified with Brahma, or the holy principle which animates Nature; in other words, the Ātman replaces the personal Prajāpati. True knowledge leads to supreme bliss by absorption into Brahmā, and this is combined with the theory of transmigration, which was fully established when Buddha arose, for he accepted it without question. This was not so much a new philosophy as a new religion, a religion without rites and ceremonies, involving existence without pain of desire, life without end, freedom from re-birth. 'The spirit of the sage becomes one with the Eternal; man becomes God[1].'

The anti-Brāhmanical reaction.

While, during the period represented by the Brāhmanas, priests were engaged in elaborating the cultus, and philosophers in studying the nature and fate of the soul, the mass of the people were little affected by such speculations, and the time was ripe for change. The reformation assumed a twofold shape: first, the rise of the two so-called 'heretical' movements, which culminated in Buddhism and Jainism; secondly, the almost contemporaneous evolution of the sectarian gods. The bright and happy life of the early Aryans, as reflected in the Vedas, had been succeeded by a period of priestly ascendancy. The mass of legend, largely framed in the interest of the

[1] Hopkins, pp. 239, 241.

dominant class, which forms the history of the time, seems to show that the Brāhmans, at least in the original seat of their power, had repressed the Kshattriya, or warrior, class. The Vaisyas were regarded as little better than contributories to the funds by which the sacrificial system was maintained; the Sūdras were quite beyond the pale of salvation. Thus for the majority of the people the future was hopeless. They were told that the misery of this present life was the result of sins committed in some previous birth; though unavoidable now, it might be alleviated in some future state by bribing the priesthood to perform a sacrifice. The Aryan Holy Land was parcelled out among a number of petty chieftains, who waged internecine war, one against the other. The prevailing tone of feeling was as pessimistic as the systems of the philosophers.

Gautama, the Buddha, c. 596–508 B.C.

The leader of one of these movements of reform was Gautama, the son of a petty prince, or headman, of a group of villages occupied by the Sākyas, one of the many Kshattriya clans in the tarai, or swampy lowlands at the foot of the Lower Himālayas. The story of his life, which can only with difficulty be disentangled from the legends which have grown round the real facts, has been often told. He is said to have enjoyed in his early years all that a life of sensuous ease could provide. Suddenly his conscience was stirred by a profound sense of the vanity of human life. Self-mortification was at this time taking the place of sacrifice, and he embraced the only course open to men of his class, which might lead to a higher spirituality—in other words, he became a Yogi, or wandering ascetic. Thereby, at the very outset of his career, he accepted the current philosophy, that a man's object should be to avoid reincarnation, and that it is Karma, 'action,' the control of passion, in short, the building up of character, which conditions any future birth. So far his hope was, as is the aim of the Hindu ascetic, merely to win salvation for himself, not to save his fellow men. Suddenly, after a course of mortification he is 'enlightened,' a view quite foreign to the thought of his day, which regarded the mechanical use of cultus and formula, uninterrupted from birth to death, as the road to salvation. Then he announced the Fourfold Truth—that life is the vanity of vanities; that birth and re-birth, the cycle of reincarnation, are the result of passion and desire; that to escape these evils desire must be destroyed by what he called the Eightfold Path—right belief, right resolve, right word, right act, right life, right effort, right thinking, right meditation. This was the Gospel which the Master, now become Buddha, 'the Enlightened One,' preached during some five-and-

forty years' wanderings in Magadha, the modern Bihār, and the neighbourhood of Benares. The chronology of his life is most uncertain. He is said to have reached the age of eighty-eight years, and the date of his death is fixed by the last critic, Mr. V. A. Smith, about 508 B.C.

Buddhism; its origin.

The religion thus founded, like Jainism, is not a religion in the common sense of the term. Both are rather, in their earliest form, monastic organizations, orders of begging fraternities, like the Dominicans and Franciscans. The monastic system was not an innovation. It was a development of the last four successive stages (*āsrama*) of the Brāhmanical schools, that of the Sannyāsī, or ascetic, the only difference being that the Brāhmanic mendicants never formed themselves into such large organizations as the Buddhists and Jains. The similarity, in fact, between the practices of the two sects arose from the circumstance that both followed the same model. On the rise of Brāhman ascendancy it seems that a tendency prevailed to restrict the entry into the stage of an ascetic to members of the priestly classes. This probably led to the growth of non-Brāhmanic orders, originally intended for members of the warrior class, to which the founders of Buddhism and Jainism both belonged. Eventually persons of other castes were admitted. It is easy to understand that these movements had their origin, not in the upper Ganges valley, the Holy Land of Brāhmanism, but in the east country, Magadha, where Brāhman influence was less predominant, and where the Kshattriya class was regarded as superior to that of the priest. Antagonism would naturally arise between the old and the new orders, and would ultimately compel the new-comers not only to discard the Brāhmanic sacrificial cultus, but even to question the authority of the Vedas. When this stage was reached, their exclusion from the pale of Brāhmanism was inevitable.

Buddhism; its relation to caste.

It would be a mistake to suppose that Buddhism and Jainism were directed from the outset consciously in opposition to the caste system. Caste, in fact, at the time of the rise of Buddhism was only beginning to develop; and in later days, when Buddhism commenced its missionary career, it took caste with it into regions where up to that time the institution had not penetrated. It must also be said that the lay members of these new orders, though they looked for spiritual guidance to their own teachers, retained the services of their Brāhman priests to perform the domestic services at birth, marriage, and death. Even at the present day many Jains permit *connubium* with a family which follows the Brāhmanic rule. Such

a woman during her married life continues the religious rites amid which she was born.

The ethics of Buddhism, again, were not the invention of the Master. Even so early as the time of the Satapatha Brāhmana, which had its origin in the same part of the country as Buddhism, we find a forecast of the teaching of Buddha. Much of the terminology is the same, without, of course, the technical Buddhist connotation; and among the teachers special mention is made of the Gautamas, a family name of the Sākyas, Buddha's tribe. The rules which the Master announced as the Truths and the Paths were in a large measure common to Brāhmanical ethical writers. The sanctity of animal life (*ahinsa*), for instance, is an old Hindu belief, arising directly from the principle of metempsychosis, which links together in one chain all living creatures, gods and demons, men and animals.

Buddhist ethics.

In its theology and psychology Buddhism ignored the speculations of the priestly thinkers. Buddha does not deny the existence of the gods; he simply declines to discuss the question. He leaves it to the priests to avert the vengeance of the gods, or to win from them boons which in his view are valueless. His standpoint in such matters is the indifference of the layman. In his metaphysics, again, he does not concern himself with the origin of things; rather he takes them for granted. He is more concerned with the practical matter of salvation. He evades the question of a supernatural Creator by explaining the Universe as Will and Idea, and placing Karma, or the ethical doctrine of retribution, in the place of a divine controlling Intelligence.

Buddhist theology and psychology.

His way of salvation is different alike from that of the Brāhman or the Jain. 'Knowledge,' writes Dr. Hopkins[1], 'is wisdom to the Brāhman; asceticism is wisdom to the Jain; purity and love is the first wisdom to the Buddhist.' Nor, again, was his faith in conflict with the other religions of his time. The two systems, Buddhism and Brāhmanism, co-existed for some fourteen centuries after the death of the Master. Certain kings and certain eras were specially Buddhistic, but the historical evidence for the continuous existence of Brāhmanism side by side with Buddhism after the period of Alexander (327 B.C.) is conclusive.

The Buddhist way of salvation.

The question may then be asked—How did a creed so pessimistic as Buddhism win the enthusiasm of the people? All it seemed to offer was the denial of the existence of the

Causes of the spread of Buddhism.

[1] p. 306.

soul; and ignoring the question of the extinction of being, it fixed the aim of the believer in Nirvāna, which meant to the Master release from that sinful condition of mind which would otherwise, according to the mystery of Karma, be the cause of renewed individual existence. What the new creed brought was the message of freedom from the Brāhmanic law of sacrifice, and it enjoined the observance of a high moral code. It was a rule of practical benevolence, gradually displacing the early ideal of mere personal salvation, and extending its blessings to all who accepted its teaching. Slowly the message spread from the Kshattriya class, to which it was first given, to the man in search of peace, whatever his race or caste might be. Most of all, perhaps, its popularity rested on the magnetic personality of the Master, whose life was spent in active benevolence, and round whom by degrees centred a body of most entrancing legend. As the faith came to be influenced by foreign beliefs, such as Gnosticism, Zoroastrianism, and Christianity, the Buddha was regarded as a divine being, on whose perfections the believer might meditate, a personal Saviour whom he might adore. These were beliefs quite opposed to the sentiment of the age, which in later times the reformed Brāhmanism was likewise forced to adopt as one of the distinctive notes of its teaching.

The Sangha, or Congregation of Monks.

Again, the strength of Buddhism largely depended on the Sangha, or Congregation of the Monastic Order. This was an institution quite alien to Brāhmanism, which, even to this day, has never dreamed of forming a Convocation. Its constitution was probably of gradual growth. At any rate, by the time of Asoka we find it a well-organized body, in possession of canonical books. The primary object of this Convocation was to frame a code of discipline for the monastic communities. But, as so often happens in similar organizations, it fell more and more under the control of precisians, and the simple rules which provided for the discipline of the monks in the period immediately succeeding the death of its founder became burdensome. By degrees the rule of life came to be even more restrictive than the Brāhmanical caste system, and ended by being a formidable barrier against spiritual independence.

Buddhism, a state religion.

The history of the Buddhist Councils by which Church government was founded rests mostly on legend. All that seems well established is that about this time a profound change occurred in the politics of Northern India, which led to the formation of a great military monarchy, that of the

Mauryas, which by the time of Asoka (*c.* 269–232 B.C.) had extended its limits much beyond the bounds of Brāhmanism. This monarchy was the creation of an adventurer, who is said to have been of Sūdra origin, and his dynasty was thus disposed to ally itself with a non-Brāhmanical order, whose aims were cosmopolitan, in contrast to the exclusiveness of Hinduism. Buddhism under Asoka thus became the state religion of the Mauryas; but it is doubtful if it really gained by its absorption into political life. The accession of worldly influence was naturally accompanied by a falling off in spirituality. To all appearance, in the period between 200 B.C. and 100 A.D. the propaganda seemed successful. It was at this time that the great ecclesiastical buildings, like the monasteries and the Stūpas at Sānchi and Bharhut, with which the history of Indian architecture begins, were erected, and the inscriptions with their records of donations by believers attest the influence of the faith. Another important development in this period was the production of images of the Buddha, an art probably originating in the Punjab under Greek influence, later on to be adopted by Hindus and Jains for the adornment of their myriad temples.

Buddhism as a missionary religion.

The transformation of a local cult into a world-wide religion was the work of Asoka alone. In Ceylon the faith introduced in the time of his contemporary, King Devanāmpriya Tisya, made rapid progress, and its adherents now number more than two millions. Thence it spread to Burma and Siam, the conversion of the former dating from the middle of the fifth century A.D. The farther progress of the faith to China and Japan lies outside the limits of the present sketch.

Later Indian Buddhism.

Returning to its fortunes in India—Buddhism secured the support of the great King Kanishka, under whom a Council was held at Jullundur about 100 A.D., or a little later. In this Council the Sinhalese branch was not represented. About this time the Mahāyāna school, which in an incipient stage was already in existence, came into prominence. In fact, the period of Kanishka marks the beginning of the decay of Indian Buddhism. 'The point of divergence of the two schools,' writes Dr. Waddell[1], 'was the theistic Mahāyāna doctrine, which substituted for the agnostic idealism and simple morality of Buddha a speculative theistic system with a mysticism of sophistic nihilism in the background. Primitive Buddhism practically confined salvation to the few; the Mahāyāna extended salvation to the entire universe. Hence the new faith

[1] p. 10.

was called the Great Vehicle, Mahāyāna; the other, in contempt, the Hīnayāna, or Imperfect Vehicle, which could carry few to Nirvāna, and which they alleged was fit only for low intellects. This, the modern Tibetan form of the faith, represents the influences of the Bhagavad-gītā and Sivaism,' with much more from a still lower order of belief.

Buddhism in decay.

What we know of the later history of Indian Buddhism is derived from the abundant sculpture and epigraphical records, and an extensive Nepalese, Tibetan, and Chinese literature. Of the Chinese Buddhist pilgrims, Fa Hian (399–413 A.D.) found the two religions working side by side, and Brāhman priests honoured equally with Buddhist monks. Hiuen Tsiang (629–45 A.D.) describes how Brāhmanism was gaining the ascendancy over the rival faith. Buddhism was most flourishing in the Ganges-Jumna Doāb, then ruled by the powerful monarch Harshavardhana, or Sīladitya. The actual decay of Buddhism seems to have set in from about 750 A.D. In the eleventh century it still held its ground in outlying provinces, like Kashmīr and Orissa, and the Pāl kings of Bihār remained true to the faith till the conquest of the province by Bakhtiyār Khiljī in 1199 A.D. The final establishment of Muslim power led to its complete disappearance from Northern India. In Western India Buddhism was in the ninth century a living religion, favoured by the authorities, and it seems to have survived till the middle of the twelfth century, when the Saiva revival was directed against both Buddhists and Jains.

Causes of the decline of Buddhism.

We can only speculate on the causes which led to the almost complete disappearance of this once dominant religion from the land of its birth. One fact seems certain, that although in some places its adherents may have suffered from active persecution, Buddhism died chiefly by reason of natural decay, and from the competition of new sects which arose under the influence of the reformed Brāhmanism. The original creed was perhaps too simple and, once the immediate pressure of Brāhmanism was removed, not sensuous enough to satisfy a people to whom a form of worship like that of Krishna was more attractive. It demanded from its followers a standard of morality much in advance of their stage of culture. It involved the discontinuance of sacrifice, and of the myriad methods by which the Hindu has ever tried to win the favour or avert the hostility of his gods. It abolished such a vague entity as Brahma, into whom every Hindu hopes to be absorbed, and it substituted Nirvāna, or extinction, as the end of all

things. Jainism, as we shall see, by its democratic constitution, retained a hold on the people which Buddhism failed to secure.

Buddhism at the present time.

Out of nearly nine and a half million Buddhists enumerated at the last Census, all but about 300,000 are in Burma. They exist in small numbers along the north and north-east frontiers of Bengal, and in the Punjab districts of Spiti, Lahul, and Kanāwar, on the lower slope of the Himālayas, where there is a considerable Tibetan element in the population. All along the Bengal frontier Buddhism is being gradually pushed back by Brāhmanism. In Nepāl it is still a powerful element, in spite of the steady opposition exercised against it by the Hindu ruling dynasty. The Burmese Buddhists are generally regarded as belonging to the Southern School, but the influence of the Northern School has contributed to mould the religion of the province in its present form. Here, though active and well organized, and educating in a somewhat imperfect way a large proportion of its youths, it is in the main of a debased type. While some sympathetic observers have found much to praise, others describe it as 'a thin veneer of philosophy laid over the main structure of Shamanistic belief. Nāt, or demon worship, supplies the solid constituents that hold the faith together; Buddhism supplies the superficial polish. In the hour of great heart-searchings the Burman falls back on his primaeval beliefs.' Attempts have been made to minimize the hostility shown to us by the priesthood during the rebellion which followed our occupation of the Upper Province. But, considering the close relations that existed between the monks and the royal Court, it is safe to accept the opinion of Mr. Lowis, that 'there were few more pertinacious and dogged opponents to the British rule in the new territory than the wearers of the yellow robe.'

Survivals of Buddhism in Bengal.

Some attention has been recently given to a supposed survival of Buddhism among the Sarāks of Bengal. Their name is said to be derived from the Sanskrit Srāvaka, 'a hearer,' a term used by the Jains to define a layman, by the Buddhists for the second order of monks residing in monasteries. In Orissa the Sarāks worship Chaturbhuja, 'the four-armed one,' a title now applied by Hindus to Vishnu, but said to be identified by the Sarāks with Buddha. A similar origin has been assigned to the Dharma worship in Western Bengal. These beliefs have clearly some affinity to Buddhism or Jainism. How far they may have been transmitted through a Vaishnava medium is not clear.

Jainism.

Jainism is the second of the 'heretical' movements which led to the establishment of the non-Brāhmanic orders, organized as a protest against the exclusion of all but Brāhmans from the ascetic fraternities. Like Buddhism, it had its rise in Magadha, and its founder, like Gautama, was drawn from the warrior class. The two teachers were contemporaries, the life of Vardhamāna extending from about 599 to 527 B.C. He is said to have been the disciple of an earlier saint, Pārsvanātha, the rules of whose order did not satisfy his ideas of stringency, one of the cardinal points of which was the custom of absolute nudity. The natural inference is that Vardhamāna, who on the establishment of his order gained the name of Mahāvīra, 'the great hero,' was only the reformer of a sect which had its origin in a still earlier protest against Brāhman monopoly of the ascetic order. The title which he afterwards assumed, Jina, 'the victorious,' gave a name to the order which he founded.

Jainism contrasted with Buddhism.

The resemblances between Jainism and Buddhism are due, not to imitation, but to the fact that the basis of both was the same. In both the goal is Nirvāna, but the term has a somewhat different connotation in the two beliefs. With the Buddhist it implies extinction; with the Jain, escape from the body, not from existence. The moral rules imposed upon neophytes are much the same in both orders. The fivefold vow of the Jains prescribes sanctity of animal life; renunciation of lying, which proceeds from anger, greed, fear, or mirth; refusal to take things not given; chastity; renunciation of worldly attachments. In its metaphysics Jainism is more closely allied to the Sankhya philosophy than is Buddhism, the former recognizing a duality, eternal matter being opposed to eternal spirit. The Jain is more careful of animal life even than is the Buddhist, and to him are due those curious institutions, known as Pinjrapols, or animal hospitals, in which creatures of all kinds, even vermin, are protected and fed. Buddha, as we have seen, laid no stress on asceticism, while among the Jains it survives in a repulsive form.

The Jain schism.

The most important event in the history of the order is the schism, which led to the separation, maintained to this day, of the Svetāmbara, or 'white-clothed' faction, who are found in the north and west of India, from the Digambara, or 'those clothed with the sky'—in other words, the naked ascetics of the south, who are probably the older. The literatures of the two factions are quite distinct, the older sacred books, the Angas and Pūrvas, being possessed only by the Svetāmbaras. The

first Jain Council, held at Pātaliputra, the modern Patna, about 310 B.C., is said to have framed the Jain canon, and from this time was laid the foundation of the schism, which did not finally occur till early in the first century A.D. During the mediaeval period, Jainism secured much political influence. It became the state religion of the Chālukya princes of Gujarāt and Mārwār, and of the kings of the Coromandel Coast. Many of its adherents held office as prime ministers in the Courts of Western, Central, and Southern India, and to this time are due the splendid series of Jain temples, such as those on Mount Abu and Girnār. On the Muhammadan conquest many of the stately Jain shrines were demolished, and their carved pillars utilized in building great mosques, such as that near the Kutb Minār of Delhi, at Ajmer and Ahmadābād.

Causes of the survival of Jainism.

Jainism is the only one of the early monastic orders which has survived to the present day in India. It escaped the disasters which overcame Buddhism, partly because its severance from Brāhmanism was never so complete; partly because it never adopted an active missionary policy, but preferred to practise its peculiar rites in a quiet, unobtrusive fashion. But the main reason is that, unlike Buddhism, it admitted to its Sangha, or Convocation, not only monks and nuns, but lay-brothers and lay-sisters. These lay brethren secured a well-established rank side by side with the monastic members, and thus among the Jains there was none of the rivalry between monk and layman which deprived Buddhism, in the later stage, of the support of the congregation at large.

Jain literature.

It is only in recent years that the vast and intricate literature of Jainism has been partially explored, and there is still much to be done in the way of translation and investigation before the history of the order can be written. This ignorance of the real nature of its teaching is perhaps one cause of the contempt which the order has excited among some Western scholars. A recent writer[1] denies the right of existence to a faith whose principles are 'to deny God, worship man, and nourish vermin.'

The Jain pantheon.

The Jain pantheon consists of a body of deified saints, Tīrthankara, 'creating a passage through the circuit of life,' or Jina, 'those who have won the victory,' twenty-four of whom are assigned to the three ages, past, present, and future. Of these the chief are the deified founders of the order, Pārsvanātha and Mahāvīra. The ascetic members of the order are known

[1] Hopkins, p. 297.

as Jati, 'the continent,' who hold no property, and never quit their dwellings except to beg for food. They carry a fan of goat's hair with which they remove every living creature from the path on which they tread, or the ground on which they sit. They wear a screen of cloth before their mouths, lest they should unwittingly inhale and destroy animal life. Their bodies and clothes are filthy and covered with vermin. The lay brethren are known as Srāvaka, 'hearers,' a title which has given rise to the name Saraogi, by which they are commonly known in Northern India. The images of the saints, statues of black or white marble, are represented as nude, in contrast to the fully-dressed figures in Buddhist shrines; but they present none of the indecencies which disfigure the modern Hindū temple. Jains choose for their sanctuaries wooded hills surrounded by lovely scenery; and in conformity with the retiring character of their creed, the older and most famous shrines are generally distant from the main centres of civilization. Such are the hill of Pārasnāth in Bengal, Pālitāna in Kāthiāwār, and Mount Abu, 'which rises with its gems of architecture like a jewelled island from the Rājputāna plains.' The piety of modern Jains in these days of toleration has adorned many of the larger mercantile cities with splendid temples, marvels of delicate carving and artistic decoration.

Jainism at the present day.

The numerical strength of the Jains is now $1\frac{1}{3}$ millions, and it shows a tendency to decrease; but this is perhaps more nominal than real, as there seems to be a growing disposition among them to describe themselves as Hindus. The line, in fact, which divides them from Hindus is narrow. They employ Brāhmans in their domestic rites; venerate the cow; often worship in Hindu temples; follow the Hindu law of inheritance, with the reservation that heirship is not dependent on the performance of funeral rites; are more than Hindu in the strictness of their caste exclusiveness; permit *connubium* with Hindus; visit Hindu places of pilgrimage. Their main difference from Hindus consists in their 'heretical' views regarding the sanctity of the Vedas, their omission of Hindu funeral rites, and their regard for special sacred places and for rites peculiar to the order. But there are Hindu sects which differ as widely from orthodox tenets without being excluded from Hinduism.

Sects and distribution of Jains.

The chief seats of Jain influence are the cities and trading marts of Western India, and the order is largely recruited from the merchants of Gujarāt and Mārwār, and cultivators in the Carnatic District of Belgaum. 'Their sudden disappearance

from the population in the direction of Sind is somewhat remarkable, and so is the fact that there are no Jains among the indigenous inhabitants of Bengal, which includes Bihār, where the religion had its origin, and Orissa, where the caves of Udayagiri and Khandagiri bear witness to its popularity in the early centuries of our era.' The faith in Northern India commends itself to the mercantile classes, because trade is the only vocation in which the rule against taking animal life can be fully observed. Even the soil cannot be ploughed without the risk of killing a worm. In Western India three sects are recognized at the present day—the Digambaras, who worship naked idols, and revere their Gurus, or spiritual teachers; the Svetāmbaras, who dress their idols in robes, and adorn them in various ways; the Dhondiyas, who worship their Gurus, wear white apparel, and a strip of white cloth over their lips. These last never worship idols. The Digambaras assert that their women do not attain salvation, a view which the Svetāmbaras reject. The lay members of the order are united by a close tie of mutual support, and their charity is boundless.

Brāhmanism modified into Hinduism.

These movements in opposition to Brāhmanism, combined with the extension of Aryan supremacy, which involved the absorption of increasing masses of the aboriginal races, led to a modification of the primitive belief. The result of this was the Hinduism of the present day, which with more or less variance of practice is now the creed of the vast majority of the people, and, like Christianity in mediaeval Europe, maintains a certain general conformity by the use of one sacred language, the veneration paid to holy places, and the predominance of a priesthood. It has hitherto been usual to date this movement within Brāhmanism as late as the eleventh century of our era; but it has recently been shown that the Purānic literature goes back to the sixth or eighth century. Thus the reform of Brāhmanism went on side by side with the growth of Buddhism and Jainism, and the three movements are but differing phases in the evolution of modern Hinduism. The means by which this evolution was accomplished were in the case of Brāhmanism twofold: first, the creation of a national ideal of worship; secondly, the combination of non-Aryan forms of belief with the older creed. The first movement finds its record in the epics, with some information to be gathered from the law literature, and a few sidelights from the inscriptions. The second is to be traced in the body of sacred writings known as the Purānas.

The epics.

During the Epic period, which may be roughly defined as

lasting from about 500 to 50 B.C., or practically contemporaneous with the spread of Buddhism in its original form, two collections of popular legends were combined into the Mahābhārata and the Rāmāyana. The first and more important of these poems was composed probably in the fifth century B.C., and reached its final stage, after a series of redactions in the interest of one sect or the other, as a didactic compendium before the beginning of our era. The original Rāmāyana may have been completed at a time when, according to Professor Macdonell, 'the epic kernel of the Mahābhārata had not yet assumed definite shape,' that is, before 500 B.C., while recent additions date from the second century B.C. or later.

The Mahābhārata.

The Mahābhārata brings together the western body of legends, that centring round the Brāhman Holy Land in the Upper Ganges valley, and deals mainly with the Kaurava-Pāndava war, in which some authorities see a tradition of the contest between two successive bodies of Aryan invaders. The transition from the earlier Brāhmanism is indicated in various ways throughout the epic. We find excessive stress laid on Yoga, or asceticism, which, with the use of Mantras, or formulae, replaces sacrifice as a means of coercing the gods. Caste distinctions are now found clearly established. The old Vedic deities have fallen from their high estate, and are now included among the Lokapālas, or 'world-guardians.' Those that still retain some measure of dignity have lost their connexion with Nature, and have become anthropomorphous. New gods, like Kubera, god of riches, Dharma Vaivasvata, who took his title from an old name of Yama, and Kāma, god of love, who in name is as old as the Atharvan, but was perhaps developed under the influence of Greek female slaves, take the place of the older gods, and with priests and the Pitri, or sainted dead, form the pantheon. The reverence paid to mountains, rivers, and holy trees reflects the older Nature-worship, reinforced by beliefs adopted from the aboriginal tribes. Hanumān, the monkey god, who appears in both epics, has been supposed to be a guardian of the village and its crops; more probably he is a loan from the local theriolatry. The reverence paid to the serpent, which, except as the dragon Ahi, does not occur in the Veda, is here associated with the Nāgās, a semi-divine snake race. The people of the same name seem to have ruled many parts of Northern India in the prehistoric period.

The Rāmāyana.

The second epic, the Rāmāyana, is less interesting from the religious point of view than the Mahābhārata. It does the

same service to the eastern body of legends, those of Kosala and Magadha, as the earlier epic did for the western folk-lore. Here the veneration paid to saintly ascetics is farther intensified. It is generally supposed to mark the extension of Brāhmanism into Southern India, but is more probably an amplification of a Vedic Nature-myth.

The religious influence of the epics.

The effect of these epics was to form a gallery of heroic personages drawn from local tradition, who have been revered by Hindus of succeeding times. Thus, in lieu of vague abstractions and the shadowy Vedic gods, now in a state of decadence, the Mahābhārata provides a series of heroic men and women—the knightly Pāndavas and their common spouse, Draupadī, as in the Rāmāyana Rāma and Sītā have formed models of the life of holiness to later generations. To this day the latter epic, transmuted into the old Eastern Hindī of Northern India by the genius of Tulsi Dās (died 1624 A. D.), is the Vaishnava Bible, and episodes from it form the subject of the most popular village drama.

Sivaism and Vaishnavism.

It is much more difficult to trace the stages of the evolution which led to the sectarian worship of Siva and Vishnu.

Vishnu in the Rig-veda plays only a subordinate part. Though included in the solar cultus, he is less frequently invoked than his brother gods, Sūrya and Pūshan. In the Grihya Sūtras he is adored in connexion with Vāk, or the Logos; Manu names him only once. In the Mahābhārata Vishnu and Siva are separate gods, but each in turn is identified with the All-God, and consequently each represents the other.

Siva, again, is the natural descendant of the Vedic Rudra combined with Pūshan; the name Siva, 'the auspicious one,' was apparently assigned to him through a feeling of euphemism, to veil the more ruthless side of his personality. The Greek Megasthenes (306–298 B. C.) identifies him with Dionysos, and speaks of him as a god worshipped in the mountains. About the end of the first century of our era, as recorded in the Periplus, the cult of his consort, Durgā, had reached and given a name to Cape Comorin. The records of the Buddhist pilgrims show that he was worshipped in Northern India five centuries later. In his earliest form, then, the Aryan origin of Siva is undoubted, and this is recognized by the Brāhmans of to-day, who specially worship him. But this does not imply that in his later forms non-Aryan elements may not have been added to his cultus. By some this non-Aryan side of his worship has been connected with the Deccan; by others with the

lower slopes of the Himālayas. Dr. Muir comes to the conclusion that, while there are not sufficient grounds for regarding the non-Aryan tribes of Southern India as specially devoted to his worship, his cultus may have owed its coarser elements to the Dravidian stock common to the whole Peninsula.

The elevation of Brahmā, the third member of the triad, to the position of chief of the gods is characteristic of the Epic period; but even here, to quote Dr. Hopkins[1], 'his character is that of a shadowy, fatherly, beneficent adviser to the gods, his children; all his activity is due to Vishnu. Brahmā is in his place merely because to the preceding age he was the highest god; for the epic regards Creator, Prajāpati, Brahmā as synonymous.' But he is already in process of subordination to the sectarian gods. This process has continued until, in modern times, the leader of the triad has become a *roi fainéant*, and only four shrines, those of Pushkar in Rājputāna, Khed Brahma in the State of Idar, Dudahi in Bundelkhand, and Kodakkal in Malabar, are known to be specially devoted to his worship. The view of modern Hinduism is that his functions are interchangeable with those of Vishnu and Siva, either of whom may be worshipped as his representative.

Vishnu and Siva compared.

To the Hindu of to-day Vishnu and Siva form the two poles of his religion. Siva, to use the words of Sir A. Lyall[2], 'represents the earliest and universal impression of Nature upon man—the impression of endless and pitiless change. He is the destroyer and rebuilder of various forms of life; he has charge of the whole circle of animated creation, the incessant round of birth and death in which all Nature eternally revolves. His attributes are indicated by symbols emblematic of death and man's desire.' These symbols represent the male and female creative energy, an idea perhaps borrowed from the non-Aryan races, and appearing already well established in the Mahābhārata. Less human and more mystical than Vishnu, anthropomorphic image-worship has little place in his cultus. Manifold are the forms in which he manifests himself. He is the typical Yogi, or self-mortifier, the philosopher and sage, the wild and jovial mountaineer, surrounded by a train of dancing revellers. How much of this is the result of syncretism it is difficult to say; but his worship was obviously well adapted to attract two very different classes of votaries—the Brāhman philosopher, who sees in him the All-God, from whom the universe is evolved; and the villager,

[1] p. 404. [2] ii. 306.

who associates him with the mysteries of reproduction. Hence, as Visvesvara, 'Lord of the Universe,' his plain, uncarved *lingam* is the chief object of worship at Benares, the head-quarters of Brāhman orthodoxy, and few of the smallest villages lack a modest shrine erected in his honour. Possibly in the latter case the preference for his worship is due to its cheapness. He needs none of the gorgeous ceremonial which is provided for Vishnu. A few flowers, an oblation of water, are all that his worshipper needs to dedicate.

The extension of Sivaism.

The extension of Sivaism was the work of two great missionary preachers. The first was Kumārila Bhatta, a Brāhman of Bihār, who is said to have instigated the persecution of Buddhists and Jains in Southern India. He taught the latter Mīmānsa philosophy, and his mantle fell on his more famous disciple, Sankarāchārya, who in the eighth century moulded the tenets of the Mīmānsa into its final form. The result of his teaching was the foundation of the Smārta sect of Brāhmans, while among the lower classes he popularized the worship of Siva. To him is attributed the foundation of monasteries from Sringeri in Mysore to Badrīnāth in Kumaun, which last is still served by Nambūri Brāhman priests from Malabar. Much of his life was spent in wandering along the hill country from Kashmīr to Nepāl, where he reorganized the temple services in the interest of his sect. His missionary work largely contributed to the downfall of Buddhism in Northern India, and the Saivas have deified him as an incarnation of Siva himself.

The Saiva sects.

The Saivas represent the conservative force in the history of Hinduism. It was from their struggles with Buddhism in the centre and south of the Peninsula that the order of the Sannyāsī ascetics, who took their title from one of the stages (*āsrama*) in the life of a Brāhman, arose. In the same way, the contest between the Sannyāsīs and the innovating Bhagats of Northern India gave rise to the Jogi order. Saivism has blossomed out into sects with less luxuriance than Vaishnavism. Some of those which have been formed exhibit asceticism in its highest and most repulsive form. Such, for instance, are the loathsome Aghoris, eaters of filth and of corpses; the Urdhvabāhus, who extend the arms over the head till the muscles wither from non-use; the Ākāsamukhins, who keep the neck bent back looking up to the sky; the Kapālikas, who use a human skull for a drinking-cup.

The Smārtas.

Two of the Saiva sects, the Smārtas and the Lingāyats, deserve special mention. The Smārtas, 'those who follow tradition (*smriti*),' are Brāhmans of the South Deccan and

Madras. Though they refer their origin to the teaching of the Saiva missionary, Sankarāchārya, they are not exclusively Saivite in their beliefs. They teach the identity of man's spirit with the One Spirit (Âtman, Brahma), which is cognizable only through meditation. They recognize the orthodox triad—Brahmā, Vishnu, Siva—as coequal manifestations of the one Eternal Spirit, and destined ultimately to be reabsorbed into this Spirit. They thus represent the highest form of Brāhmanic pantheism. Brāhmanism in Southern India has always claimed to preserve a higher standard of orthodoxy than that which prevails in other parts of the country. Its activity is shown by the fact that the reforming mission of Sankarāchārya had its origin there, and at the present day the Brāhman of Madras exercises an influence much greater than that of his brethren in the North. The explanation of this is that the South was not involved in the struggle with the Kshattriyas and Buddhism, and was beyond the reach of the persecution which accompanied the early Muslim invasions.

The Lingāyats.

On a much lower level are the Lingāyats, 'wearers of the *lingam* or phallus.' The founder of the sect was Basava, the southern form of the Sanskrit Vrishabha, a title of Nandi, the bull on which Siva rides. He was a Brāhman of Bijāpur, and prime minister of Bijjala, one of the Kalachurya kings of Kalyāni (*circa* 1145–67 A.D.). The story of his career is overlaid with a mass of legend, the Lingāyat account being embodied in the Basava Purāna, while the Jain narrative contained in the Bijjalarāya Charita is very different. From the Lingāyat account it would seem that Basava and his nephew took advantage of their official position to persecute the Jains and other enemies of the new faith. But Bijjala himself was a Jain, and a reaction occurred, which culminated in the death or abdication of the king and the murder of Basava.

The sect is chiefly found in the Southern Deccan, where they call themselves Vīra-Saivas, 'brave or fierce Saivas,' but are popularly known as Lingāyats or Lingavants. The chief characteristics of the sect in its early days were adoration of the *lingam* and of Nandi, Siva's bull, and disbelief in the transmigration of the soul. They rejected infant marriage, and permitted widows to remarry. Their chief seat is in the Kanarese country, and it is mainly due to their influence that this powerful and polished language has been preserved. The main body of the community, who are initiated by what is known as the 'eightfold sacrament' (*ashtavarna*), are known as Panchamsālis, descendants of the original Brāhman converts.

To these has been added a group of later converts. At the outset caste distinctions were abolished, but, as is so often the case with religious movements of this kind, a reaction set in. The original, or high-caste section, introduced a more elaborate form of worship, framed on the Brāhmanic model. The new converts were forced to take a lower place, and only the Jangamas, or priests, being a privileged class, deigned to share their food. This schism, which began at the close of the seventeenth century, has continued, until at the last Census the higher group claimed to be recorded as Vīra-Saiva Brāhmans, and proposed that the others should be placed in three classes according as they sprang from castes ranking as Kshattriyas, Vaisyas, or Sūdras.

Vishnu and Vaishnavism.

According to the view of most foreign students of Hinduism a sharp line is to be drawn between the beliefs of the Saiva and Vaishnava sectarians. But Hinduism is wonderfully eclectic, and the two sects are regarded as complementary, rather than antagonistic. While Siva, the god of destruction and reproduction, is associated with many practices at once grotesque and repellent, the faith of the worshippers of Vishnu is more human, impersonating the 'higher evolution,' the upward tendency of the human spirit. It leads the believer back to the graceful worship of the early gods, while it has included in its pantheon the forms of national heroes, who live among men, and furnish an ideal of manliness, beauty, and the delights of love. In his highest form Vishnu is in a state of repose, not activity, which is the note of Saiva beliefs. He occasionally deigns to revisit the earth in human or animal shape by a succession of Avatāras or incarnations. This theory of successive divine embodiments is one of the most effective doctrines of the later Hinduism. In it the eclecticism and adaptability of the faith are most fully realized. In the animal incarnations we may see either an indication of the absorption of the totemistic or beast gods of the lower races, or, from the esoteric point of view, the pantheistic idea of the divine spirit immanent in all the forms of creation. In the deification of heroes we have a development of one of the main principles of the Hindu renaissance, which first begins to show itself in the Mahābhārata.

The gods of Vaishnavism.

The forms of Vishnu are manifold. In Travancore, where he is the state deity, he is worshipped as Padmanābha, 'he from whose navel springs the lotus.' But, as popular gods, his most important incarnations are Krishna and Rāma.

Krishna.

Both Krishna and Rāma may, in their earliest conception,

be embodiments of local deities of the herd or cornfield, but to the Hindu they are glorified men, who once lived on earth. Krishna, whose name first appears in one of the Upanishads as a scholar, is a prominent personage in the Mahābhārata, but always invested with some degree of mysticism. The head-quarters of his cult are at Muttra, on the upper Jumna, which, as shown by a recent important discovery of inscriptions, was an early seat of Jainism. The suggestion has been made that there was some alliance between the two faiths, and that one cause of the immunity of Jainism from persecution in Western India was the protection it received from the new Vaishnavism. But this is improbable. Krishna, in the early form of his cult, may be regarded as the local god of some Rājput clan settled near the Jumna; and his titles, Govinda and Gopāla, 'the herdsman,' suggest a connexion of his worship with that of a god of flocks and herds. He is also the hero of the Pāndava tribe, who seem to have been newcomers, opponents of the orthodox Brāhmanism of the Holy Land. The mention of polyandry among them in the case of Draupadī has been supposed to connect them with the Himālayas, where this custom still prevails. In the cult of Krishna we have that form of Vaishnavism which, by its luxurious ceremonial and lax standard of morality, shares with Jainism the respect of the moneyed middle class.

Rāma.

In Rāma, the god of the orthodox Brāhman, there is no erotic suggestion. He, like Krishna, seems to have been a local Rājput hero of Kosala, and in his personality are embodied the legends and folk-lore of the east country. Here, in the birthplace of Buddhism, his cult arose, and it is clear that it was largely indebted to the older faith. Or perhaps it might be a more correct statement of the case to say that both alike were dependent upon the earlier Brāhmanic tradition. At any rate Vaishnavism, as it appears in the cult of Rāma, preserves the kindliness and charity of Buddhism, as well as its tenderness for animal life.

The growth of Vaishnavism.

The foundations of the Vaishnava beliefs were laid in the Vishnu Purāna, a work which was formerly supposed to date from the eleventh century, but has now been proved to be some five centuries older. We thus naturally find in it much of the old caste exclusiveness, which the Institutes of Manu, representing probably the conditions of the second century, most fully display. There is in the Purāna one God, but he is the God of the Brāhman, and the writer does not dream of the message of salvation being extended to the lower races.

The popularization of the creed was the work of a line of reformers, of whom the first was Rāmānuja, a South Indian Brāhman, who is said to have lived between 1017 and 1137 A.D. In the case of Vaishnavism, as with Saivism, the inspiration for reform came from the south. Rāmānuja, in opposition to Sankarāchārya, maintained that there was one supreme Spirit; that individual beings are separate spirits, and the universe non-Spirit. Fifth in succession to him was Rāmānand, who lived during the fourteenth century, and was the missionary of popular Vaishnavism in Northern India. He preached the worship of Vishnu under the form of Rāma, either singly, or conjointly with his consort, Sītā. But his chief innovation was the introduction of low-caste disciples into the communion.

The Vaishnava reformers.

One of his twelve disciples was Kabīr (1380–1420 A.D.), who carried on and extended the work of his master. His teaching is specially remarkable inasmuch as in later times it inspired the founders of Sikhism. Its chief note is to link Hinduism with Islām. A weaver by caste, Kabīr taught the spiritual equality of all men. Alī or Rāma, said he, are only different names for the same God. So we are told that on his death both Hindus and Musalmāns claimed his corpse. But when they raised the shroud they found nothing but a heap of flowers. The Hindus took half and cremated them at Benares; the Muslims buried the other half near Gorakhpur. Kabīr, in accepting the equality of all men before the Supreme, added to his doctrine the spiritual application, that difference in caste, rank, or religion, the changes and chances of this mortal life, are but Māya, or Illusion. Emancipation and peace are to be gained by recognizing the Divine Spirit under these manifold illusions. The way to happiness is not by formula or sacrifice, but by fervent faith (*bhakti*) and meditation on the Godhead. A large sect, known to the present day as Kabīrpanthis, follow his teaching. Their special principle is the duty of obeying the Guru, or spiritual guide, though at the same time Kabīr recognized freedom of individual judgement. The use of meat and liquor and the worship of idols were prohibited. But nowadays practice lags behind precept, and many members are said to show a tendency to revert to idolatry. It is perhaps more as a writer than as a religious reformer that Kabīr has left his mark on the beliefs of Northern India. His apophthegms are ever on the lips of the educated man, whether Hindu or Musalmān, and have been largely incorporated into the Granth or Sikh Scripture.

Kabīr and Kabīrpanthis.

Chaitanya. The preaching of the new creed in the Bengal delta was undertaken by Chaitanya (1485–1527 A.D.), who was, writes Mr. Gait, 'a Baidik Brāhman. He preached mainly in Central Bengal and Orissa, and his doctrine found ready acceptance amongst large numbers of the people, especially amongst those who were still, or had only recently ceased to be, Buddhists. This was mainly due to the fact that he drew his followers from all sources, so much so that even Muhammadans followed him. He preached vehemently against the immolation of animals in sacrifice, and the use of animal food and stimulants, and taught that the true road to salvation lay in Bhakti, or fervent devotion to God. He recommended Rādhā worship, and taught that the love felt by her for Krishna was the highest form of devotion. The acceptable offerings were flowers, money, and the like; but the great form of worship was the Sankirtan, or procession of worshippers playing and singing. A peculiarity of Chaitanya's cult is that the post of spiritual guide, or Gosain, is not confined to Brāhmans, and several of those best-known belong to the Baidya caste.'

Erotic Vaishnavism. Teaching of this kind, in which special regard is paid to the erotic side of the Krishna cult, inevitably led to abuse. The lowest form of such teaching is found among the Vallabhāchārya sect, which has its chief seats in Western India and at Gokul near Muttra. They have been called the Epicureans of the East, and the Gosain, or leader of the sect, is regarded as a divinity, and his votaries are at his disposal—body, soul, and substance. The licentious practices of this community were exposed in the famous Mahārāja suit at Bombay in 1862.

Sikhism. Sikhism is one of those movements which started as a religious reform and ended in becoming a political organization. Founded in the Punjab by the Guru Nānak (1469–1538 A.D.), it was farther developed by succeeding Gurus, notably by Guru Govind Singh (1675–1708 A.D.). 'The Sikh creed,' writes Mr. Rose, 'involves belief in one God, condemning the worship of other deities; it prohibits idolatry, pilgrimage to the great shrines of Hinduism, faith in omens, charms, or witchcraft; and does not recognize ceremonial impurity at birth and death. As a social system it abolishes caste distinctions, and, as a necessary consequence, the Brāhmanical supremacy and usages in all ceremonies, at birth, marriage, death, and so on. But this creed is probably accepted and acted upon by a very small number even of those who call themselves true Sikhs.' The main object of the early Gurus was to distinguish their

disciples from the Hindus among whom they lived. Hence Guru Govind prescribed that every Sikh should bear the five marks, known as the five *ka*—the hair uncut (*kes*), the short drawers (*kachh*), the *kara*, or iron bangle, the *khanda*, or steel knife, the *kangha*, or comb; that he should abstain from tobacco, and eat no meat save that of animals decapitated by a single blow at the back of the neck. In later times a tendency to assimilate themselves more and more to Hindus began to prevail, and many Sikhs accepted the ministrations of Brāhmans, and made pilgrimages, especially to Hardwār, where the Ganges leaves the lower hills. This tendency is now being opposed by the orthodox teachers, who have their head-quarters at Amritsar, and the principles of the Granth, or Sikh Bible, are more stringently enforced. The teaching of the Gurus in matters of faith was little more than an exposition of the principles of Kabīr. The formula of Nānak was the Unity of God and the Brotherhood of Man. The strength of Sikhism lay not in the novelty of its message, but in the social observances, which were designed to stimulate the local patriotism of its members and to make the followers of the Guru a peculiar people.

The Sāktas.

The third great sect which shares with Saivas and Vaishnavas the allegiance of Hindus is that of the Sāktas. It is based on the worship of the active female principle (*prākriti*), as manifested in one or other of the forms of the consort of Siva—Durgā, Kālī, or Pārvatī. The forces of Nature are here deified under separate personalities, known as Divine Mothers, an old idea, now revived with fresh and more impure associations. The ritual of the sect, which prescribes blood-offerings and other abominable libidinous rites, is found in the Tantras, embodying cruder forms of belief, which are as old as the Atharva-veda, but have been farther developed subsequently. The cultus seems to have arisen in Eastern Bengal or Assam about the fifth century A.D., and was opposed by the Vaishnava reformers. It has left its mark in the later Buddhism, and unhappily seems to be spreading in Upper India under the encouragement of Bengali clerks.

Modern Vaishnava sects: the Rādhāswāmīs.

The most interesting phase of the reformed Vaishnava movement appears in the modern sects, which owe their inspiration to Kabīr. Thus, in the United Provinces the Rādhāswāmīs, founded by Shiu Dayāl Singh, a Khattrī of Agra (1818–78 A.D.), recognize the separate existence of God, the soul, and matter. According to them the universe is divided into three spheres—the first, the abode of the

Supreme Being, about whom nothing can be predicated; the second, presided over by a Spirit, who is curiously described as 'the Lord God of the Bible, the Sat of the Vedantists, and the Lahaul of the Muhammadan Saints.' The ruler of the third sphere, in which matter predominates over Spirit, is compared to the 'Brahm, or Paramātma, or God of most religions in the world.' By resignation to the will of the Supreme transmigration is avoided, and the end of the series of re-births comes when the purified souls, after passing from plants through the lower created forms to man, reach the presence of the Supreme Being, and remain there, but without losing individuality. The sect has no temples and no priests, but the spiritual head of the community is highly revered. Contemplation of his image is held to be the contemplation of the Supreme Being, and is one of the chief ordinances of the faith.

Sects founded on social revolt.

In many cases these dissenting sects have taken the form of social rather than religious revolts. They were efforts on the part of the lower castes to free themselves from the tyranny of the caste system and the Brāhmans who stood at its head. It is significant that many of the reformers sprang from the lower ranks. Rāmānand, himself a Brāhman, had among his disciples who founded separate schools Nāmdeo the cotton-printer, Sena the barber, Kabīr the weaver, Nābhaji the Dom.

The Satnāmis.

One of the most important of these movements was that of the Satnāmis, founded in the beginning of the seventeenth century by an Oudh Rājput, Jagjīvandās, and extended among his own caste by the Chamār Ghāsidās, between 1820 and 1830 A.D. The seven principles prescribed by Ghāsidās included abstinence from spirituous liquor and certain vegetables, like lentils and tomatoes, whose juice resembles blood; the abolition of idol worship; the prohibition of the use of cows for ploughing (an old Gond custom, now tabooed as a sop to the Brāhmans), or of working oxen after midday, a rule designed for the prevention of cruelty to animals. 'This creed,' writes Mr. Russell, 'was marked by a creditable simplicity and purity of too elevated a nature for the Gonds of Chhattīsgarh. The crude myths which are now associated with the story of Ghāsidās, and the obscenity which distinguishes the ritual of the sect, furnish a good instance of the way in which a religion, originally of a high order of morality, will be rapidly debased to their own level when adopted by people who are incapable of living up to it.'

The latest stage of these efforts to reform Hinduism is found in the modern Theistic sects, which had their origin in Bengal. 'Brahmoism,' writes Sir A. Lyall[1], 'as propagated by its latest expounders, seems to be Unitarianism of a European type, and as far as one can understand its argument, appears to have no logical stability or *locus standi* between revelation and pure rationalism; it propounds either too much or too little to its hearers.' Its founder was the celebrated Rām Mohan Roy (1774–1833), and his successors, Debendranāth Tagore, Keshub Chunder Sen, and Pratāp Chunder Mozūmdār. As at present constituted, the Brahmo Church is divided into three sections, all alike believing in the unity of the Godhead, the brotherhood of man, and direct communion with God in spirit, without the intervention of any mediator. The differences which exist are ritualistic and social, rather than religious. The Adi Samāj, or oldest section, is also the most conservative. While discarding all idolatrous forms, it follows as closely as possible the rites of Hinduism, and draws its inspiration solely from the religious books of the Hindus, especially the Upanishads, and not from the Bible or Korān. It has only once allowed a non-Brāhman to officiate as its minister. Inter-caste marriages are not allowed, and a considerable agitation was raised when one of its Brāhman members recently married the daughter of the Mahārāja of Cooch Behār. The Nabibidhan Samāj, or Church of the New Dispensation, was founded by Keshub Chunder Sen. It is more eclectic, and has assimilated what it considers true, not only from the holy books of Hinduism, but also from the teaching of Christianity, Buddhism, and Islām. The Sadhāran Brahmo Samāj is the most advanced of these Churches. It rejects caste and seclusion of women, freely permits inter-caste marriage, and is uncompromising in its rejection of what is commonly called Hinduism. Though as yet a small body, it attracts Hindus who have received their education in England, as they are thus absolved from the trammels of caste, and spared the necessity of undergoing any rite of purification on their return to India.

Modern Theistic sects: the Brahmo Samāj.

Another of these societies, the Arya Samāj, has gained considerable influence in North-western India. Founded by Dayānand Saraswatī (1827–53), it regards the Vedas as the only Scripture, professes a pure monotheism, repudiates idol worship, and largely devotes itself to the social amelioration of the race. One of the publications of the founder had some

The Arya Samāj.

[1] i. 153.

effect in promoting the agitation against cattle-slaughter, which led in recent years to serious popular disturbances. The Samāj has suffered from internal dissensions, and is at present divided on the question of the lawfulness of animal food.

Sectarianism in modern Hinduism.

In considering the practical effect of sectarianism on modern Hinduism, it may be said that, while the lines of cleavage between the manifold sects are clearly marked, it would be an error to suppose that Hinduism is divided into so many water-tight compartments, between which no communion is possible. Such a result would be quite alien to the eclectic spirit of the system. There may be a certain amount of hostility felt by the leaders and inner circle of believers against the adherents of a rival sect; but beyond these lies the great mass of the people, who are, as a rule, ignorant to which sect they belong. The majority of high-caste Hindus in North India worship all the gods of the Hindu pantheon, each man, according to his fancy, paying special respect to Siva, or to one of his consorts, or to Vishnu in one or other of his many incarnations. The Brāhman will keep in his private chapel the Sālagrāma, or ammonite representing Vishnu, as well as the phallic emblem of Siva. At the great places of pilgrimage he will worship the sectarian gods as he meets their images in his tour round the holy site; he will attend the popular celebrations in honour of either god, such as the Durgā-pūjā or the miracle play of Rāma. The continuity of religious life is seen in its sacred places. Their sanctity has come down from a time probably antecedent to the rise of the historical religions, and each creed in succession has consecrated some holy site to the needs of its culture. Thus, Benares and Muttra were centres respectively of Buddhism and Jainism. The cult of Siva has accepted the one and that of Krishna the other, the new faith often erecting its temple on the very spot consecrated to that which preceded it. Even the more modern religions have adopted the old sacred places. For example, at Sakhi Sarwar, at the foot of the Sulaimān range, Hindus perform their rites of prayer and ablution, Sikhs venerate a shrine of Nānak, and Musalmāns the tomb of a Muhammadan saint.

Animism.

Up to this point we have dealt with the historical, literary, and what may be termed the official, development of Hinduism. But below the upper crust of observances which Brāhmanism and Buddhism enforce, there is a mass of more primitive beliefs, which form the real faith of the majority of the people. This jungle of diverse beliefs and cults has been classed under the unsatisfactory title of Animism, by which is meant the

belief which explains to primitive man the constant movements and changes in the world of things by the theory that every object which has activity enough to affect him in any way is animated by a life and will like his own. The leading features of Animism, as summarized by Mr. Risley, are: 'It conceives of man as passing through life surrounded by a ghostly company of powers, elements, tendencies, mostly impersonal in their character, shapeless phantasms of which no image can be made and no definite idea can be formed. Some of these have departments or spheres of influence of their own: one presides over cholera, another over small-pox, another over cattle disease; some dwell in rocks, others haunt trees, others, again, are associated with rivers, whirlpools, waterfalls, or strange pools hidden in the depths of the hills. All of them require to be diligently propitiated by reason of the ills which proceed from them, and usually the land of the village provides the means for their propitiation.' Some rude stones piled under a sacred tree, a mud platform where a tiger has killed a man, a curiously shaped rock which is supposed to have assumed its present shape from some supernatural agency, are the shrines of the Animist. His priest is not drawn from the Brāhman order, and the office is often not hereditary.

Animism in its purest form.

Animism in its purest form shows itself among the forest races in the centre and south of the Peninsula, and on the lower slopes of the Himālayas. Some of these founded kingdoms of their own, like the Gond princes of Garhā Mandlā, Deogarh, and Chānda in the Central Provinces, the Koch of North-east Bengal and Assam, the main line of whose dynasty is now represented by the Mahārāja of Cooch Behār. The tribes whose beliefs are Animism of this kind are in many cases falling rapidly under Hindu influence. Such is the case with the Santāls, Gonds, and Bhīls, who occupy the hills south of the Gangetic valley. Over such people the yoke of the Brāhman missionary is easy. He enforces no hard moral code; he asks but that the convert should employ a faithful priest, and conform to the ordinances of a more respectable religion than that which he believes in common with the semi-savages around him. The tribes occupying the southern hill country, like the Badagas, Irulas, and Kurumbas, and the fierce races, like the Nāgās, who inhabit the lower ranges on the Assam frontier, have remained comparatively free from Brāhman influence. The missionary influence likely to affect the races of the Madras hill country will probably be Christian rather than Hindu.

The enumeration of Animists.

The Census returns of 1901 reckon the number of Animists at about 8½ millions. The method employed was to class as Hindus or Muhammadans persons who named these as their religions; the remainder, or those who classed their religion as tribal, say that of Gonds or Bhīls, were recorded as Animists. Such a classification is of no practical value, simply because it ignores the fact that the fundamental religion of the majority of the people—Hindu, Buddhist, or even Musalmān—is mainly animistic. The peasant may nominally worship the greater gods; but when trouble comes in the shape of disease, drought, or famine, it is from the older gods that he seeks relief. The greater gods are in his mind busied about the more important affairs of the universe, and have no time to listen to him when his ox is stolen, or when he desires a son to succeed him.

Origin of Indian Animism.

Animism of the kind we now see in India is no doubt largely derived from the non-Aryan races, among whom it flourishes with the greatest vigour. But, in the absence of literary evidence, we may suspect that the animistic current runs through the whole course of Indian religious history, that the Vedas may have been confined to the priestly class, and that from the beginning of things the common folk may have adored the monkey and snake, or the stone which they supposed to embody their gods. Indeed the Vedic religion was Animism of the higher kind, as is shown by the worship of the heavenly bodies and the powers of Nature, each of which was believed to be controlled by some indwelling spirit.

The religion of the peasant.

Such being the basis of the religion of the peasant, it may be added that there is at the present day a tendency to believe in one supreme God, whose relations with the other objects of popular belief are not clearly defined. The rustic hopes to be carried after death to meet his fathers, who have gone before, in a heaven where he will enjoy a similar but a higher life than that of earth. Hell awaits the man who neglects the ordinances of his creed rather than the evil-doer. His religious duties are performed not so much with a view to improve his prospects of the life to come, as to avert the malignity of the evil influences by which he believes himself to be surrounded, or to gain some temporal blessing. With this object he visits holy places, and in particular bathes in holy rivers, that he may absorb some of the benign influence of the spirits which reside there. With morality his religion is little concerned, except so far as he may follow the precepts of some Guru, or religious teacher, whose position is quite distinct from that of the Purohita, or family priest. The latter, in an ortho-

dox Hindu family, is always a Brāhman, and to him is entrusted the performance of the domestic rites at birth, marriage, and death. The Guru is usually a member of one of the ascetic orders. He whispers into the ear of the initiate a Mantra or formula, which is to guide him to holiness, and at his periodical visits he instructs and admonishes his disciples. But, for the ordinary rustic, it is caste and the Panchāyat or caste-council that enforce the only moral code which he understands. He is charitable, but is seldom influenced by altruistic motives, his sympathies hardly extending beyond the members of his own family, clan, or village. In his general beliefs he is eclectic. He will worship any new gods whom he deems powerful for good or evil; hence he shows little intolerance of other forms of belief, except when the fundamental principles of his own faith are endangered. If he be a Musalmān, he knows little beyond the formal usages of his creed, and though he addresses Allah in the mosque, it is to the old village gods that he resorts when trouble befalls him.

Islām.

Passing on to the other religions, we need not attempt to trace their progress except so far as it was influenced by their Indian environment. If we dismiss the early trading settlements on the west coast and military operations in Sind, the first real contact of Islām with Hinduism occurred just at the close of the tenth century of our era. The invasions of Mahmūd of Ghazni, though they resulted in the occupation of the Punjab, were raids with the demolition of an idol or the plunder of a temple city as their object, rather than serious attempts at conquest. It was not till the end of the twelfth century that Muhammad Ghori overthrew the Hindu dynasties of Delhi and Kanauj, and opened the way to Muslim domination. To the historian of religion the most important result of this conquest was that the temporary overthrow of the Rājput powers resulted in the dispersion of the clans, some of whom emigrated to Rājputāna, which became the stronghold of Hinduism in North India, as Travancore is in the south. Others were driven down the Ganges valley, and became the headmen of villages occupied to this day by their descendants in Oudh, Bihār, and along the lower reaches of the river. It was not till early in the sixteenth century that the Mughal power was established under Bābar and his successors. During the five centuries which intervened between the raids of Mahmūd and the final establishment of Muslim power in India, Buddhism and Brāhmanism suffered the grievous stress of war and rapine at the hands of rude troopers from Central

Asia, who believed that they earned the favour of God by slaying the priests and demolishing the temples of the infidel. But forcible proselytism was probably uncommon, except at the hands of some soldier bigot like Sikandar Lodī. The position of the early Muhammadan dynasties was too precarious to admit of any general propaganda. Even in the time of the early Mughals, the emperors were too indifferent towards spiritual affairs, too much engrossed in schemes of conquest and administration, to undertake the task of conversion in earnest. Their power was in a large measure dependent on alliances with the Rājput princes; the native princesses whom they married brought a strain of Hindu blood into the royal line, and promoted tolerance of Hinduism. It was only in the later years of the Empire, when it fell into the hands of the fanatical Aurangzeb, that we hear much of persecution and forcible conversion. In Southern India the Muhammadan rulers seem generally to have been tolerant, with the signal exception of Tipū Sultān, but his policy had little effect on the religion of his kingdom, where at present only about five per cent. are Muhammadans. The Marāthās seem to have followed the tradition of the Muslim dynasty of Bijāpur, and in their turn to have treated the rival faith with tolerance.

The progress of Islām.

Islām is most powerful in those parts of the country where the invaders settled down, not only as conquering rulers, but as proprietors of the conquered soil. Its numbers are not so large in the neighbourhood of the capital cities of Agra and Delhi, because it was here met by well-organized Hindu tribes. Thus, in the Punjab, setting aside the special ethnical conditions of the north-western frontier, Muhammadans are in excess, not in the eastern districts dominated by Delhi, but in the region of the west and south, drained by the Indus and its tributaries. In Kashmīr a large body of the people embraced the faith, probably because from the time of its introduction in the fourteenth century until the end of the sixteenth the country was ruled by its own Musalmān princes, and after the Mughal conquest by Akbar it became the favourite summer residence of the Court. After the downfall of the Empire it fell under the control of the Afghāns, bigoted adherents of the faith, until the establishment of a Hindu dynasty in 1819. Going farther east, the Mughal armies never occupied the slopes of the Himālayas, and here Hinduism remained undisturbed, as was the case in the country south of the Jumna ruled by the intractable Bundelās,

and along the Rājputāna frontier where it was confronted by the most powerful and united Rājput clans. It was in Oudh and the eastern districts of the United Provinces that Islām made more rapid progress, because it here met a newly established population, which was readily influenced by the powerful Musalmān colonies founded in its midst. But, in the main, Islām has progressed not so much by direct conversion as by its own vitality. In Eastern Bengal, where its numbers have increased during the last twenty years from eight to eleven and a quarter millions, the Muhammadan has gained ground because he is better able to contend with the unhealthiness of the climate. He eats meat and other more nourishing food than his Hindu neighbours; he encourages the remarriage of widows; he sets his face against the marriage of infants. The result is that his family is larger and longer-lived. Again, generally throughout the country the Musalmān is a dweller in cities. He is on the whole better fed and less exposed to famine and disease than the Hindu, who is often a landless field labourer, the hardest and worst-paid occupation in India.

Animism: its effect on Islām.

In the rural districts Islām has been largely affected by its Hindu environment. If it has gained some converts from Hinduism, it has borrowed from it many of those practices which distinguish it from the original faith of Arabia. By degrees the fervid enthusiasm of the early raiders was softened down; the two religions learned to live side by side; and if the Muhammadan of the later days could never conceal his contempt for the faith of his 'pagan' neighbours, he came to understand that it could not be destroyed by persecution. From the Hindus Islām derived much of its demonology, the belief in witchcraft, and the veneration of departed Pīrs, or saints. The village Musalmān of the present day employs the Hindu astrologer to fix a lucky day for a marriage, or will pray to the village god to grant a son to his wife. This is the more natural because conversion to Islām, whenever it does occur, is largely from the lower castes. It is one of the most democratic religions in the world, and welcomes to full franchise the low-caste man groaning under the contempt which meets him at the hands of his haughtier neighbours.

The Pachpiriyas.

The most remarkable instance of the fusion of Islām and Animism is found among the Pachpiriyas of Bengal and the United Provinces. They take their name from the worship of the Pānch Pīr, or Five Saints. Some have traced the cult to the five Pāndava heroes of the Mahābhārata; but the five

deities usually worshipped reckon as their leader Ghāzī Miyān, who is said to have been a nephew of Sultān Mahmūd of Ghazni, and to have fallen as a martyr to the faith at Bahraich in Oudh in 1034 A. D. With him are sometimes joined four of his fellow martyrs. But the list changes almost from District to District, and displays a remarkable compound of Muslim hagiology grafted on Animism. Thus, one of the five saints is Aminā Satī, the ghost of some faithful widow who died on her husband's pyre; or Bhairon, who in name at least represents Siva in one of his terrible forms, Bhairava, 'the ruthless,' but is probably a village god imported into Brāhmanism. Five small clay mounds in a corner of the house, or under the holy village tree, form the shrine of this quintette of divinities, and the officiant is always a member of one of the lowest castes.

Sects of Islām: Sunnis and Shiahs.

The main sects of Islām are the Sunnis and the Shiahs. The schism arose within the first century after the death of the Prophet, the Sunnis, or Traditionalists, accepting the Sunnat, or collected body of usage, as possessing authority concurrent with or supplementary to the Korān, a view which the Shiahs reject. Shiahs maintain that the Imāmate, or temporal and spiritual headship of the faithful, was by divine right vested in Alī and his descendants through Hasan and Husain, the ill-fated grandsons of the Prophet. They necessarily reject as usurpers the first three Imāms—Abu Bakr, Umar, and Usmān—whom the Sunnis respect. The former observe the annual feast of the Muharram in memory of the martyrdom of Alī and his two sons, while the Sunnis celebrate only the tenth day of Muharram, and abhor the *taziās*, or representations of the tombs of the martyrs, which the Shiahs parade in procession. Sunnis are largely in excess in Turkey and India; Shiahs in Persia and Afghānistān, their chief seats in India being Lucknow and Hyderābād. The Shiah movement, in fact, is strongest where there is least Arab intermixture in the population. Hence some have defined it as an Aryan protest against Semite domination.

Minor sects of Islām.

The well-defined, clear-cut monotheism of Islām is much less favourable to the growth of sects than is polytheistic, eclectic Hinduism. In Islām the sectarian movement usually follows one of two lines: it is either puritanical or pietistic.

The Wahābis.

A type of the first class of sect is that of the Wahābis, founded by Ibn Abdul Wahāb, at Nejd in Arabia, early in the eighteenth century. It was an attempt to restore the primitive practices of Islām, which, in the view of the founder,

had become corrupted during its world-wide career of conquest. The new doctrine was introduced into India by Sayid Ahmad Shāh, who proclaimed a Jihād, or holy war, against the Sikhs in 1826, and founded the colony of fanatics on our north-western frontier, which has been a constant source of trouble to the Indian Government. Wahābis accept the six books of traditions as collected by the Sunnis, but reject the glosses of the Church theologians, and claim liberty of conscience and the right of private interpretation. They insist strongly on the Unity of God, which, they say, has been endangered by the reverence paid to the person of the Prophet, to the Imāms, and to saints. Hence they condemn pilgrimages to shrines. In their view ordinary Musalmāns are Mushrik, or those who associate others with God. They discountenance the use of rosaries, and regard tobacco as unlawful. From a political point of view the most dangerous doctrine of the sect was to assert that India is *dāru-l-harb*, i. e. 'the land of warfare,' against the rulers of which to wage war is a religious duty. Much controversy has arisen regarding this doctrine. While some members of the sect undoubtedly accept it, it would seem that the fanatical element in the movement has for the present died out in many parts; and in Bengal the efforts of the reformers, who now prefer to call themselves Muhammadi, or Ahl-i-hadīs, 'followers of tradition,' are specially directed to the eradication of superstitious practices not sanctioned by the Korān, and to the inculcation of the true principles of the faith.

The second sectarian movement in Islām tends in the direction of Sūfiism. This is, to quote Professor Palmer, 'a strange combination of the pantheism of the Aryan race and of the severe monotheism of their Semitic conquerors, and aims at leading men to the contemplation of spiritual things by appealing to their emotions. The keynote of the system is that the human soul is an emanation from God, and that it is always seeking and yearning to rejoin the source from which it sprung. Ecstasy is the means by which a nearer intercourse is obtained, and absorption in the divinity is the ultimate object to be attained.' These doctrines, with more or less variance of practice, are accepted by the leading Sunni orders, such as the Chistiyas and Kādiriyas. Outside these are the Be-shara, or non-orthodox orders, who, while calling themselves Musalmāns, do not accommodate their lives to the principles of any definite creed. These furnish the most desperate Musalmān fanatics. Sūfiism.

The Ahmadiyas.

The wildest development of recent sectarianism in Islām is furnished by the Ahmadiya sect, which has its head quarters in the Punjab. Its leader, Mullā Ghulām Ahmad, in a recent manifesto claims to be the counterpart of the Saviour of Christianity, and to be the Mahdi or Messiah expected by Musalmāns and Christians alike. The Korān is to him the repository of all knowledge. The resurrection is at hand. While discouraging religious war, he is said to preach strongly against Christianity, Hinduism, the Shiah doctrines, and the movement in favour of English education.

Moplahs, Bohras, Khojas.

Three notable phases of Muhammadan religious life are illustrated by the Moplahs, the Bohras, and the Khojas. The Moplahs (Māppilla) are found to the number of nearly a million in Malabar. They are believed to be in a large measure descended from Arab immigrants, who landed on the western coast in the third century after the Hijra. This tribe is remarkable for the savage fanaticism displayed in successive revolts against Hindus. They have several times resisted the bayonets of English troops. The Bohras, or 'traders' of Western India, fall into two groups—the mercantile branch, originally Shiahs of the Ismaīliya sect, and the land-holding section, who are generally Sunnis. Both are mainly converts from Hinduism, disciples of Abdullah, an Arab missionary, who landed in the eleventh century. In the trading branch the Daūdi Bohras are fierce sectarians, strongly opposed to Sunnis and other Musalmāns not belonging to their sect; while the land-holding branch has in recent years been much influenced by Wahābi teaching. The Khojas, or Kwājas, 'honourable converts,' also of the Ismaīliya sect, owe their origin to Hasan Sabāh, an Ismaīliyan teacher of the eleventh century, known to the Crusaders as the Old Man of the Mountain, about whom many strange legends are told. His present representative is the well-known Agha Khān of Bombay. They are active traders on the west coast of the Peninsula and in East Africa.

The Islām revival.

In Northern India Islām displays a genuine deepening of religious life, in the direction of increased religious instruction for the young, and translations of the sacred books into the local dialects, of which cheap copies are widely circulated in the country districts. Combined with this, a desire for education has spread among the higher classes, of which the most noteworthy result has been the foundation of the Anglo-Oriental College at Alīgarh, which represents the progressive party in Islām, opposed to fanaticism, and welcoming the science of the West.

The second of the foreign religions is Mazdaism, the Pārsī faith, which takes its name from Ahura Mazda (Ormuzd), the spirit of good, who, according to the dualistic hypothesis, contends with Angro Mainyūsh (Ahriman), the spirit of evil. It is also known as Zoroastrianism, from Zoroaster, the Greek rendering of the old Iranian Zarathushtra, the modern Persian Zardusht. Mazdaism appears to have its roots in the common faith of the Aryan peoples before their separation into the Iranian and Indo-Aryan branches. But the fission occurred before the religion had been organized, and the elements common to the two are difficult to trace. What is most striking in the relations of the two faiths is that in the Avesta the evil spirits are known as Daeva (modern Persian Dīv), a term which the Indo-Aryans applied, in the form Deva, to the spirits of light. By a similar inversion, Asura, the name of the gods in the Rig-veda, suffered degradation, and at a later date was applied to evil spirits; but in Irān, Ahura was consistently applied in the higher sense to the deity, especially as Ahura Mazda, 'the wise,' to the Supreme God. Later on the two faiths came in contact again under Darius, when he occupied the countries to the north-west of India; but this intercourse led to little positive result, and meanwhile the Iranian creed had assumed a form quite different from that of the Indo-Aryans. Mazdaism.

This was the work of Zoroaster, whose date is quite uncertain, authorities variously assigning him to the fourteenth or the eleventh century B.C. It was apparently to him that the inverted use of the terms Daeva and Ahura is due. When he comes on the scene we find a contest proceeding between two cults, the higher classes being represented by that of the Ahura, who were cattle-breeders, and venerated the cow. Below them were the Daeva worshippers; and the success of Zoroaster marks the degradation of the Daeva, and the belief in the dualistic system of the universe, in which Druj, 'falsehood,' or Ahriman (Angro Mainyūsh), the spirit enemy, contends with Ahura Mazda. This faith received much of its new elements from Mesopotamia. Submerged for a time by the Greek invasion, it gained a temporary revival under the Sassanid dynasty, and finally was overthrown by Islām, which directed its energies to the suppression of the worship of fire.

At this stage many of the survivors were forced to emigrate to India. Ormuz formed an intermediate stage in their wanderings. Finally, in 717 A.D., they arrived at the little port of Sanjān, sixty miles north of Bombay. There they re-established The Pārsī emigration to India.

the sacred fire, the seeds of which they are said to have brought with them from Persia, and came to be known as Pārsīs, or Persians. They gained the favour of the local chieftains, increased and multiplied, until finally they established relations with the Mughal Court, some of their priests even visiting the Emperor Akbar, who, in his spirit of eclecticism, dallied in turn with Brāhman Pandits, Portuguese missionaries, and Pārsī fire-worshippers. Up to the middle or end of the eighteenth century Surat, Navsāri, and the neighbouring parts of Gujarāt were their head-quarters. The commercial predominance of Bombay attracted large numbers to that city, from which they have now spread all over India and the emporia of the East in quest of trade.

Mazdaism on Indian soil.

At first their weakness and their Hindu environment reacted on their faith, and their creed became hardly distinguishable from the lower Hinduism by which they were surrounded. Their isolation checked the development of their religion, and the sacred Canon was already finally closed. But their prosperity and immunity from persecution attracted fresh immigrants from Irān. The patriotic feeling of the race aroused fresh interest in the national faith, and in recent years the old sacred language has been diligently studied, and the sacred books have been edited and translated. This revival of national feeling has also encouraged the renewal of intercourse with the oppressed remnant who still live under Persian rule, in whose interest the open-handed liberality and political influence of the powerful Bombay houses have been vigorously exercised.

Pārsī religion.

The Pārsīs number at present on Indian soil 94,000, of whom all but 7,000 are found in Bombay and Baroda. They are divided into factions: Kadīmi, 'the older,' and Shenshāi, 'royal,' the point of difference being the mode of reckoning the sacred year. The former, as their name implies, assert that they follow the more primitive practice. The modern Pārsī retains the dualistic theory of the two spirits contending for mastery. The soul after death passes to a place of reward (Bihisht), or of punishment (Dozakh). Conduct in life conditions the fate of each man after death, and the duly performed rites of descendants help the soul to happiness. Fire, water, the sun, moon, and stars are the creation of Ahura Mazda, and are revered. Zarathushtra, the Prophet, is venerated; Soshios, his son, will, they believe, be reincarnated, destroy evil, purify the world, and make Mazdaism supreme. Among their rites the most remarkable is the exposure of the dead on the so-called Towers of Silence.

From the statistics it appears that the number of Indian Jews has increased within the last twenty years from 12,000 to 18,000. This increase cannot be attributed to immigration, because India with its astute native mercantile races and low wages of labour offers little attraction to the foreign Jew. There are two well-established Jewish colonies, one at Kolāba in Bombay, the other at Cochin on the Malabar coast. The Bombay Jews, known as Ben-i-Israīl, 'sons of Israel,' are believed to have reached India from Yemen about the sixth century A. D.; some authorities, however, assign their immigration to the time of the Dispersion, others to the fifteenth century A. D., while local tradition fixes their arrival in the second century of our era. The Cochin Jews assign their arrival to the first century, and there seems little doubt that they were on the Malabar coast in the eighth century. Ancient copperplate grants in their favour, and their partial amalgamation with the native races, indicate their early origin. Both Jewish colonies recognize a white and a black section, the latter being those who have more completely coalesced with the native population. Jews.

The history of Christianity in India begins with the establishment of the Syrian Church in Malabar, which claims, on authority now generally discredited, to have been founded by the Apostle St. Thomas, whose missionary labours seem to have ended in the dominions of Gondophares, apparently in Lower Sind. This Church was certainly in existence as early as the beginning of the sixth century. When it first emerges into history it formed a branch of the Nestorian community, which, expelled in the fifth century from Europe and Africa, became the leader of the Asiatic Church, with the Patriarch of Babylon as its spiritual head. He supplied the Nestorians with bishops of the Chaldean or Syrian rite, the existence of which at the present day on the Malabar coast is thus explained. It was, however, when Nestorianism prevailed in Persia that it spread thence to India. The life of this Church in India was troublous, due to the efforts of the Portuguese to bring it under the control of Rome. This was nominally effected at the Synod of Diamper (Udayamperūr, near Cochin) in 1599. The result was that the Syrian rite, purged of its Nestorianism, was retained. In 1653 many of its members revolted from Papal control. A schism then occurred. A Carmelite Mission in 1660 succeeded in bringing back most of the Indian Christians to the fold of Rome. The independence of the remnant of the Syrian community was secured by the support of the Dutch, Christianity.

then masters of the coast. In this way arose the two branches which still exist: the Old Church, or Syrian Catholics, owning allegiance to their own bishops under the Patriarch of Antioch, and retaining the use of the Syrian tongue in their services; and the New Church, or Jacobites, who maintain some dogmas and rites of their own, but are affiliated to Rome.

Catholic Missions.

The first regular Portuguese Mission, under brethren of the Franciscan Order, arrived in 1500 A.D. Its progress was slow, and its work was mainly confined to the Portuguese settlements, till the advent of St. Francis Xavier in 1542. The Malabar coast and the southern districts of Madras were the scene of his labours. After ten years' constant exertions, he sailed for the Further East in 1552, and died soon after on the coast of China, whence his remains were removed, and now rest under a gorgeous shrine in the Church of Bom Jesus at Goa. The Church which he founded adopted missionary work under principles less polemic than those of the earlier Portuguese preachers. Its missionaries, like the celebrated Abbé Dubois in much later times, assumed the habits, dress, and often the titles of Brāhmanic ascetics. They laboured to found an indigenous Church, with a priesthood recruited from the native races, and with this object in view they recognized caste among their converts, a concession which was a cause of much controversy in after-times. The Jesuit Mission in Madura dates from 1606, and with it are associated the names of Robert de Nobili, its founder, who died in 1656, and John de Britto, martyred at Madura in 1693. The parochial organization and industrial schools founded by the Jesuits still survive. These Catholic Churches came under the control of the Inquisition, founded at Goa in 1560, and surviving until its dissolution in 1812. The work of the Jesuit Mission was much impeded by the action taken in Europe against the Order, and it suffered grievous persecution, particularly at the hands of Tipū Sultān, who about 1784 forcibly converted to Islām and deported above the Ghāts a large number of Christians. Meanwhile the tolerance, or indifference, of Akbar and his successors permitted the foundation of Catholic Missions in Northern India, which, if less successful than those of the South, led to the establishment of a Church which survives to the present day.

Protestant Missions.

The first Protestant Mission was established in 1705 by the Lutherans Ziegenbalg and Plutschau, who started their work at Tranquebar under Danish protection. To the former and his successor, Schultze, is due the first Protestant version of the Scriptures in an Indian vernacular. The devoted Swartz

(1750–98), the founder of the famous Tinnevelly Mission, succeeded to their labours. The work of the Lutheran Missions has now, to a great extent, passed into the hands of the Society for the Propagation of the Gospel. The Mission to Calcutta was founded by Kiernander, a Swede, who reached India in 1758. Carey, in spite of opposition from the East India Company, established himself at Serampore in 1799, and founded the Baptist Mission, famous through the literary labours of Marshman and Ward. It was not till 1814 that the Company consented to the foundation of the episcopal see of Calcutta under Bishop Middleton, who succeeded to the work of the devoted Henry Martyn (1806–11), one of the chaplains of the Company. The missionary work of the Church was stimulated by the journeys, recorded in his valuable *Diary*, of the second Bishop of Calcutta, Heber. The first missionary of the Church of Scotland was Dr. Duff, one of the pioneers of higher education in India.

The Christian community now numbers nearly three millions, of whom more than two and a half millions are native converts, and the remainder Europeans or Eurasians. Of the Native Christians about two-fifths are Roman Catholics, and one-eighth Romo-Syrians; one-ninth belong to the Anglican body, one-eleventh are Jacobite Syrians, one-twelfth Baptists. Of the other sects the best represented are the Lutherans and allied denominations, who claim 6 per cent. of the total, the Methodists 2½, the Presbyterians 1½ per cent. The Christian community.

Nearly two-thirds of the total Christian population are found in Madras, including the Native States of Cochin and Travancore. In these States, where the Syrian Church is strongest, nearly a quarter of the entire native population profess Christianity. In British territory, it is in the eight southern Districts, the scene of the labours of St. Francis Xavier and Swartz, that Christians are most numerous. Then come the Districts of the Telugu country—Kistna, where they are mainly Baptists and Lutherans; Nellore, nearly all Baptists; and Kurnool, Baptists with a respectable minority of Anglicans.

Next comes Bengal with 278,000 Christians, of whom 228,000 are natives; and of these about half are found at Rānchī, in Chotā Nāgpur, where Missions of the Lutheran, Anglican, and Roman Catholic bodies are busily engaged among the forest tribes. Oraons, Mundās, and Khariās supply the majority of converts, those from Hinduism being few, and these do not come from the higher ranks of Hindu society.

Farther north, at Champāran in Bihār, the Roman Catholic Mission has an interesting history. The work of the missionaries began in Nepāl and Tibet, but they were expelled from Nepāl by the newly established Gurkha dynasty. They fled with many of their converts to Bihār, where some of the present Christians are descendants of the original fugitives, still speak their own language, but have intermarried with the Native Christians of the land of their exile.

In the United Provinces the Christians number 103,000, of whom 69,000 are native converts, or nearly treble the numbers at the last decennial Census. The increase appears chiefly in the three western Divisions, where the American Methodist Church 'devoted its efforts chiefly to the very lowest castes, and consequently has to be satisfied with a lower standard of appreciation of the tenets of Christianity than many other Missions require from their converts.'

As regards the other Provinces of the Empire, in the Punjab out of 72,000 Christians, 39,000 are natives. Here, again, the increase has been startling; they numbered only 4,000 in 1881, and are now nearly twice as numerous as they were ten years ago. Delhi, with the Cambridge Mission under the Society for the Propagation of the Gospel, and a Baptist Mission, shows the largest increase; but with this exception the progress of Christianity is confined to the western part of the area, where Sikhism has been most powerful. In Bombay Native Christians have increased during the last ten years from 130,000 to 181,000. Of these 105,000 are Roman Catholics, 'descendants of converts made by the Portuguese several centuries ago, who at the present day are ignorant and unprogressive.' The remainder is made up of recent converts to a variety of sects, among which the Salvation Army and the Anglican Church take precedence. The figures show a large increase in the number of children, and 'the secret of many of the conversions is to be sought more in the relations which the missionary bodies have been able to establish with the famine waifs in their orphanages, than in any general movement in the adult members of non-Christian communities towards accepting the revelation of the Gospel.' In Assam the Christian population, which now numbers 36,000, has more than doubled in the last ten years, largely the result of efforts of the Welsh and Baptist Missions among the hill tribes. In Burma, where converts have increased in ten years from 71,000 to 129,000, progress has been most rapid among the Karens, who are more amenable

to missionary effort than the Buddhist population. It is only since the annexation that missionaries have enjoyed free opportunities in Upper Burma, and the full harvest of their work is still to be reaped.

Progress of Christianity in the Empire.

Throughout the Empire the progress of Christianity in the period between 1872 and 1901 has been remarkable. It has about doubled its numbers in thirty years, rising from an aggregate of one and a half to nearly three millions. Naturally Native Christians are most largely recruited from the classes outside the Hindu system. The missionary view lays stress on the labours of the early missionaries, the efficiency of the present body of workers, the dissemination of translations of the Scriptures, the improved status of Christians won by their own exertions, the spread of education, benevolence in seasons of famine, and lastly, the impartiality and disinterestedness of the British Government, which has conferred so many benefits upon the people, and is known to be influenced by Christian principles. The question of the large increase in Madras has been discussed from another point of view by Mr. Francis, who points to the improved social position enjoyed by the low-caste man who embraces Christianity. He sums up by saying: 'The remarkable growth in the numbers of Native Christians thus largely proceeds from the natural and laudable discontent with their lot which possesses the lower classes of the Hindus; and so well do the converts, as a class, use their opportunities, that the community is earning for itself a constantly improving position in the public estimation.'

W. CROOKE.

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CHAPTER IX

POPULATION

General characteristics of Indian as compared with Western peoples.

THERE is probably no subject connected with India regarding which it is less easy to make statements of general application than that of its people. The area is great; the physical features and climate are highly diversified; and the population is derived from many different sources. The Dravidians of the south are the earliest inhabitants of whom we have any knowledge. From the north-west countless hordes of many different stocks, including in historic times Greeks, Scythians, Huns, Afghāns, Mughals, and Persians, have, from time immemorial, found their way into India, driven thither by the pressure of other hordes behind them, or attracted by the prospect of plunder. Along the northern border the Himālayas oppose an impassable obstacle to the passage of large bodies of men, and the number of immigrants from this direction was never very large; but on the north-east the difficulties of transit to a great extent disappear, and there has been an extensive influx of various Mongoloid races. The inhabitants of Assam and Burma belong in the main to this stock, and the same element enters very largely into the physical type of the Bengalis. To these racial differences must be added variations due to environment, which have been developed in the people during the course of the many centuries that have elapsed since their first settlement in India[1]. In the north-west the dry climate, and the incessant struggles with man and nature in which only the fittest could survive, have combined to produce a brave and hardy race of good physique; while the easy life in the steamy and fertile rice plains of the Gangetic delta, though encouraging a rapid increase in the number of its inhabitants, has sapped their energies and stunted their growth. The small, weak, and timid Hindu peasant of Bengal differs from the tall, sturdy, and brave Sikh, or the turbulent and active Pathān, to a greater degree

[1] The Āhoms are known to have greatly degenerated, both physically and morally, in the course of the seven centuries during which they have been settled in Assam, and this period is a very short one compared with that for which the bulk of the people of India have been domiciled there.

than does the Scandinavian from the Spaniard or the Englishman from the Turk. The contrast is not less marked between the Gurkha and the Madrasi, between the Bhotiā of the Darjeeling hills and the Mundā or Oraon of Chotā Nāgpur, or between the Angāmi Nāgā and the Marāthā. The variations in type are often personal as well as local; and in some Provinces the higher castes may be regarded as being (with more or less intermixture of blood) the modern representatives of the Aryan and other dominant tribes who came to India in comparatively recent times, while the lower castes are composed in the main of the earlier inhabitants whom they subjugated[1]. The Indian Muhammadans are mostly the descendants of local converts; but they have received a certain infusion of foreign blood which, in Bengal at least, is often indicated by their sturdier frames, more prominent noses, and greater energy, as compared with their Hindu neighbours and congeners.

With these marked differences in physical type, there are equally noticeable divergences of social practices, dietary, and manner of living. At the same time, the people of India as a whole can be distinguished from those of Europe by certain broad characteristics. The native of India is, with a few marked exceptions, of slighter build and weaker frame than the European; his diet is, often from choice and often from necessity, wholly or mainly vegetarian; he is deficient in energy and in capacity for sustained hard labour; his earnings are much smaller, but his wants are simpler and more easily met—food grains are cheap, rents low, houses inexpensive, and clothing is often a matter of decency rather than of necessity. With the Hindus marriage is an obligatory religious sacrament, and is practically universal: on the other hand widows are often prevented from taking a second husband, and as girls are generally married at a very early age, this restriction renders unproductive a considerable section of the female population of child-bearing age. With the Musulmāns, Animists, and

[1] The Aryans have fine, and the Dravidians broad noses, and the influence of race upon caste has been epigrammatically stated by Mr. Risley in the dictum that a man's social status varies inversely with the width of his nose. This apophthegm emphasizes a point of difference which, though more easily gauged than others, is by no means the only one. There are, for instance, remarkable variations in stature; and while in many Sikh regiments the average height exceeds 5 feet 8 inches, in regiments recruited from Nepāl it is only 5 feet 3 inches. The higher castes have usually a fairer skin, a higher forehead, less prominent lips and cheek-bones, and a more graceful figure than those at the bottom of the social scale.

Buddhists there is no religious sanction enjoining wedlock, but the practice is almost equally common; the age at marriage is, however, higher than in the case of Hindus, and there is no bar on widow marriage, though it is often viewed with disfavour. This universality of marriage tends to produce a rapid increase of population, and although this may sometimes be hindered by preventive checks, such practices are believed to be rare. There are, however, well-marked positive checks; for the sanitary conditions prevailing in India are by no means favourable to longevity. The water-supply is often polluted, and in many rural areas no effort is made to remove filth and refuse from the neighbourhood of the houses in which the people live. They are thus exposed to diseases of all kinds, especially to epidemics of cholera, small-pox, and plague; malarial affections and bowel complaints are also in parts very prevalent. In the case of infants these adverse conditions are aggravated by unskilful midwifery, exposure, and improper food. The normal rate of mortality is thus very high, especially among young children. In years of drought it rises still higher, not so much on account of direct deaths from starvation, as through dysentery and diarrhoea due to the eating of improper food, general debility, and the epidemics of cholera so frequent in famine years.

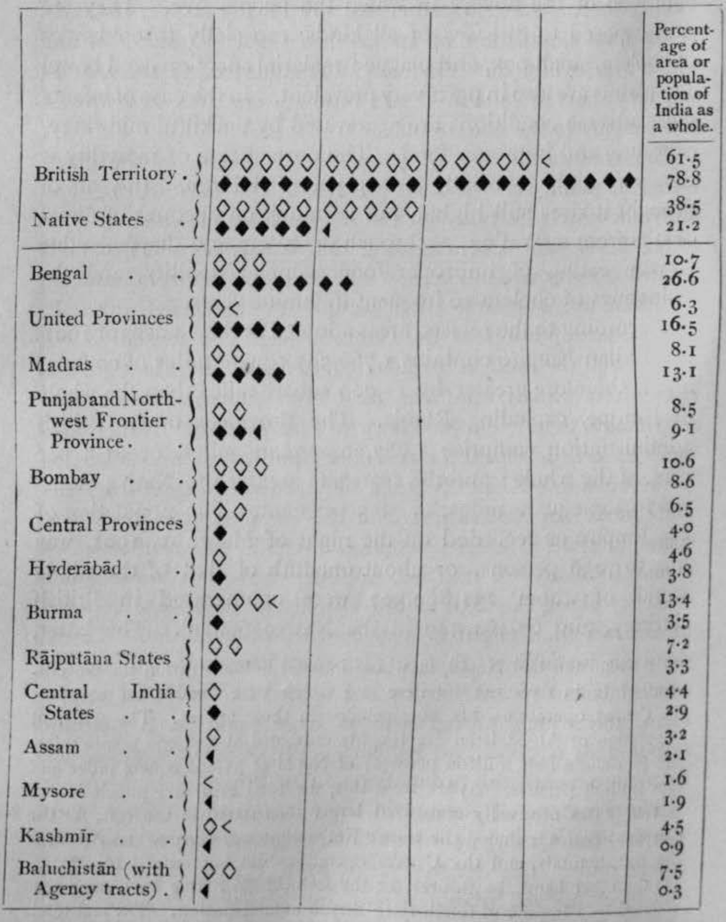
Area and population of India.

According to the revised areas adopted in the Census of 1901, the Indian Empire contains 1,766,597 square miles of country, and is therefore greater by 12,000 square miles than the whole of Europe, excluding Russia. The Provinces under British administration comprise 1,087,204 square miles, or 61·5 per cent. of the whole; and the aggregate area of the Native States is 679,393 square miles, or 38·5 per cent. The population of the Empire as recorded on the night of March 1, 1901, was 294,361,056 persons, or about one-fifth of that of the whole world, of whom 231,899,507 were enumerated in British territory, and 62,461,549 in the Native States[1]. The latter,

[1] Afghānistān and Nepāl, in whose internal administration the Government of India does not interfere and which were outside the scope of the Census operations, are not included in these figures. The area and population of Afghānistān are roughly estimated at 246,000 square miles and four and a half million persons; of Nepāl at 54,000 square miles and four million persons. Apart from this, the total area and population of Native States are really somewhat larger than stated in the text, for the Census statistics included the minor Native States of Burma and Assam in the British totals, and the Census operations did not extend to Bhutān. On the other hand, the figures for the Baluchistān States have since been reduced by a transfer of territory to British administration. The real totals for Native States would now be, approximately—area, 765,000 square miles; population, sixty-four millions.

therefore, while containing more than one-third of the total area, support considerably less than a quarter of the population. In India as a whole the average density is 167 persons to the square mile, viz. 213 per square mile in British territory and 92 in the Native States. There are, however, great local variations; and while the fertile and well-watered alluvial tract forming the Gangetic plain supports upwards of 400 inhabitants per square mile, the great desert in the west of Rājputāna has barely five.

The following diagram brings out the relative area and population of the various Provinces and the chief Native States.



NOTE.—States under Local Governments are treated as part of the British Province concerned for the purpose of this diagram.

Each white diamond therein represents 4 per cent. of the total *area* of India, and each black diamond 4 per cent. of the total *population*.

If we take smaller areas as the basis of comparison, the differences become even more striking. A classification by Districts shows that a fifth of the total population of the country is congregated on less than a twentieth of the superficies, where there are more than 600 persons to the square mile; a quarter more on a twelfth of the country, where the density is from 400 to 600 per square mile; and nearly a fifth on an eighth of the area, at a density of 200 to 400 per square mile. Taking these figures together, we find that nearly two-thirds of the total population of India occupy only a quarter of the whole area, while the remaining three-quarters of the area is still very sparsely inhabited and nowhere contains as many as 200 persons to the square mile.

The greatest density of population is found in the great Gangetic plain, and the next greatest in the narrow fringes of alluvium which lie between the sea and the elevated interior of the Peninsula. As a general rule, it may be said that high or low density is concomitant with large or deficient rainfall; but there are, of course, other factors to be reckoned with. In the western portion of the Gangetic plain the rainfall is not large; but the want is supplied by artificial irrigation from a network of canals, and the land thus supports many more inhabitants than it could otherwise find food for. Much also depends on the character and configuration of the surface, as in the uplands of Chotā Nāgpur, where there are extensive areas quite unfit for cultivation, and the population is thus very sparse in spite of a fairly copious rainfall. The influence of climate is also well marked, and the malarious *tarai* which stretches along the foot of the Himālayas possesses far fewer inhabitants than might be expected from its rainfall. Lastly, there are variations due to historical causes, as in Burma, which has but recently enjoyed a settled and civilized government, and which, though half as large again as Bengal and favoured by a good and regular supply of rain, possesses less than one-seventh the population of that Province.

Population and density in the various Provinces, &c. Assam.

The Province of Assam, in the north-eastern corner of the Empire, has 6,126,343 inhabitants, or an average of 109 to the square mile. The density varies from 353 per square mile in the open alluvial plains of the Surmā valley to 108 in the valley of the Brahmaputra—which, though in parts very fertile, contains large areas that are unhealthy or unfit for cultivation,

and suffered until early in the nineteenth century from pillage and rapine—and only twenty-seven in the hills of the Assam Range and Lushai, where much of the land is uncultivable and the memory of head-hunting and predatory expeditions is in some parts still fresh.

Bengal. The great Province of Bengal[1], with more than seventy-eight million inhabitants (including 3·7 millions in the Native States attached to it), has, on an average, 413 persons to the square mile. Among its natural divisions the highest density (636 per square mile) is found in the alluvial plains of North Bihār, and the lowest (152) among the hills and ravines of the Chotā Nāgpur plateau. Between these extremes the other divisions follow an order dependent in the main on their relative fertility. Central Bengal has 608 persons to the square mile; West Bengal, which contains the populous Districts of Hooghly and Howrah, 591; East Bengal, 514; South Bihār, 511; the coast strip of Orissa, 508; while North Bengal, which is traversed by the sparsely populated semi-laterite formation known as the Bārind, drops to 483, the lowest density in the plains of the delta. The most thickly peopled District is Howrah, where the attraction of lucrative employment in the jute mills has raised the mean density of the entire area to 1,668 persons per square mile, and that in rural areas, excluding the city of Howrah and the municipality of Bally, to 1,351. Jute cultivation does for Dacca what jute manufacture does for Howrah: a soil enriched by perennial silt and watered by an unfailing rainfall here supports 952 persons per square mile. In North Bihār, the country of the petty proprietor, who clings to the soil at the cost of endless subdivision of property, Muzaffarpur has a density of 917 per square mile, and Sāran of 907. The scantiest population is found on the outskirts of the Province, where the density falls in some parts to twenty-three to the square mile.

Bombay. The Bombay Presidency, with a population of 25,468,209, of whom more than a quarter are in the Native States, has an average of 135 persons to the square mile. Except along the Indus and the canals fed from it, the whole of Sind is a desert, and the density is only half the general mean. South of Sind, the fertile and well-cultivated plains of Gujarāt support a population of 267 to the square mile. Below the wall of the

[1] In 1905, an extensive scheme of redistribution was effected, by which Eastern Bengal, with Assam, became a new Lieutenant-Governorship, while transfers of territory were also made between Bengal and the Central Provinces. See Table IV A (p. 491).

Western Ghāts, which run in a continuous chain from Gujarāt to South Kanara, the rice-bearing areas on the coast, sure of a regular rainfall on the first contact with the south-west monsoon, have a density of 221 to the square mile. The Deccan table-land, cut off by the hills from the main onset of the monsoon, has a scanty and uncertain rainfall, and the density falls to 159. In the extreme south, above the Ghāt line, the Bombay Carnatic, more fortunate than the arid plains of the Deccan, enjoys fair immunity from risk of crop failure and finds support for 190 persons per square mile.

Burma.

With an area of 236,738 square miles, the population of Burma is barely ten and a half millions. The mean density is only forty-four persons per square mile, but it rises to fifty-five if the sparsely inhabited Shan States and Chin Hills be left out of account. The sub-deltaic tract of Lower Burma lying round Prome has ninety persons to the square mile. The dry zone of Upper Burma, with its centre about Mandalay, comes next with seventy-nine. Then follows the coast strip, from the borders of Chittagong to the Malay Peninsula, with fifty-five; and last of all comes the wet tract of Upper Burma, which contains only fifteen persons to the square mile.

Central Provinces.

The population of the Central Provinces, including Berār[1] and the dependent Native States, is 14,627,045, and the mean density is 109 persons per square mile—161 in the Nāgpur country, 155 in Berār, 145 in the Narbadā valley, 114 in the Vindhya plateau, and 78 in the Districts adjoining the Sātpurā range.

Madras.

The Madras Presidency has forty-two and one-third million inhabitants (of which somewhat more than four millions belong to its Native States), or 270 persons to the square mile. The density is greatest on the west coast (368 per square mile), and least in the Agency tracts—the forest-clad ranges which form the background of the three northern Districts—where it is only sixty-nine. In the Deccan it is twice as great as in the Agency tracts. On the east coast, the Telugu country, which includes the deltas of the Godāvari and Kistna rivers, has 303 persons to the square mile; and the Tamil country to the south of it, with the fertile delta of the Cauvery river and the area commanded by the Periyār irrigation scheme, 358. In the Tanjore District, in this tract, the density rises to 605 per

[1] The Province of Berār (area 17,710 square miles; population 2,897,491) appertains to the Nizām of Hyderābād, but has been administered since 1853 by the British Government, to which it has now been granted on perpetual lease. It was attached to the Central Provinces in October, 1903.

square mile, while in one of the tāluks in the Cochin State, on the west coast, it reaches the phenomenal figure of 1,920, or 133 more than in the Srīnagar *thāna* of the Dacca District, the most thickly peopled rural area in Bengal.

Punjab and the North-West Frontier Province.

In the Punjab and the North-West Frontier Province taken together, but excluding Malakand, Dīr, Swāt, and Chitrāl, and the Baloch trans-frontier area in the Shirāni country, the population is a little less than twenty-seven millions, and the average number of persons to the square mile is 180. British territory in the Punjab has a density of 209 per square mile; the Frontier Province, 141; and the Punjab States, 121. Of the natural divisions, the Indo-Gangetic Plain, west, has 316 persons to the square mile; the Sub-Himālayan tract, 300; the north-west dry area, 97; and the Himālayan area, only 77. In British territory the density ranges from 641 in Jullundur District to forty-two in the Kurram valley. The Chenāb Colony, a desert recently transformed by irrigation into a garden, has already 214 persons to the square mile, a denser population than twelve out of the twenty-eight Districts in the Punjab as now constituted.

United Provinces.

The population of the United Provinces is about forty-eight and a half millions (800,000 in Native States), and the average number of persons to the square mile is 432, viz. 445 in British territory, and 158 in the two Native States. The Himālayan west region, i.e. the mountainous tract in the north, has only eighty-seven people to the square mile. In the south, British Bundelkhand and Mirzāpur District have 202 and 207 respectively. The other natural divisions exhibit a continuous increase in density from west to east. The western Sub-Himālayan Districts support 441 persons to the square mile, and the eastern 566; in the Gangetic plain 546 are found in the western portion, 577 in the central, and 751 in the eastern. Excluding cities, there are twelve Districts with less than 400 persons per square mile, fourteen with between 400 and 500, and twenty-two with a higher density. The most populous District is Balliā, in the extreme east, which supports 791 persons on each square mile of area.

Native States.

The statistics for the Native States other than those already referred to along with the Provinces may be more briefly dealt with. Baroda, with barely two million inhabitants, has 228 persons per square mile; the Central India Agency, with $8\frac{2}{3}$ millions, has 109; and the Rājputāna Agency, with $9\frac{3}{4}$ millions, has 76. The mean density in the latter case is greatly reduced by the almost waterless desert in the west and the broken and

forest-clad country in the south: in the eastern States it rises to 165 persons per square mile, which is nearly as great as that of the most populous part of the Central India Agency. The Kashmīr State is one of the most sparsely peopled tracts in India, and with 81,000 square miles of area has less than 3 million inhabitants, or 36 per square mile. The population of Hyderābād exceeds 11 millions, and there are 135 inhabitants to the square mile: the density is greatest in the eastern and southern tracts. Mysore has $5\frac{1}{2}$ million inhabitants and a mean density of 188 to the square mile: in the open level country to the east the density is 200, and in the hilly country sloping down from the Western Ghāts only 124.

Towns and villages.

For Census purposes the term 'town' was held to include all municipalities and cantonments, and any other continuous collections of houses, permanently inhabited by not less than 5,000 persons, which seemed to possess a distinctly urban character. One-tenth of the people of India were enumerated in places answering to this description: of these more than half were found in places with at least 20,000 inhabitants, about one-fifth in towns of from 10 to 20 thousand, and the rest in smaller towns. The tendency towards urban aggregation is most marked in Bombay, Berār, and Rājputāna, the homes of the Mārwārīs, Pārsīs, and other enterprising trading communities; and least so in Bengal, and in various remote tracts on the borders of the Empire where there is but little trade and the means of communication are inferior. The smallness of the urban population in Bengal may be ascribed partly to the character of its people, who have no great genius for trade; partly to its past history, which has not been such as to encourage the growth of towns save at the old seats of government; and partly to the absence of any considerable seaport except Calcutta. In Bengal proper, and in the Punjab, where the Muhammadans are most numerous and are drawn mainly from local sources, they appear to take less readily to a town life than the Hindus; but elsewhere the reverse is the case, and in the United and Central Provinces, in Madras, and in many of the adjoining States the proportion of Muhammadans in towns is double that of Muhammadans in the population at large.

According to the Census returns there are 728,605 villages in India, with an average population of 364, but these figures refer to units of a very heterogeneous character. In some places the village was taken to be the area demarcated in the course of a survey, corresponding more or less to the English

parish or the Teutonic mark, while elsewhere it was a collection of houses bearing a separate name, i.e. a residential village. The character of the latter also varies greatly. Sometimes, as in the Deccan, the people reside in walled and fortified villages, a reminiscence of the troublous period which preceded British rule, and which, in Baluchistān[1] and the Frontier Province, led also to the erection of towers of refuge to which the villagers might betake themselves in time of danger. Elsewhere, as in Bihār, the fortifications disappear, but the houses are still closely packed together with no intervening spaces for orchards or gardens. Elsewhere again, as in the greater part of Madras and Bengal proper, the houses, while still collected on a common site, are well separated and each stands in its own ground. Sometimes, as in Upper Assam and on the west coast of the Madras Presidency, there is no regular village site at all, and each cultivator makes his dwelling-place where it suits him best, either in the centre of his fields or on some adjacent patch of high ground, such as the bank of a stream. In the joint delta of the Ganges and Brahmaputra, where the country is heavily inundated during the rainy season, the houses are congregated within very narrow limits, on mounds laboriously thrown up during the winter months when the water temporarily disappears.

Recent growth of towns. The list of places treated as towns in 1901 differs from that of the previous enumeration; and the Census figures, which disclose an apparent increase of 7·3 per cent. in the urban compared with an increase of only 2·4 per cent. in the total population, cannot therefore be wholly relied on. But there is no doubt that towns are growing in both number and population, owing to the expansion of large industries, such as cotton and jute mills and railway workshops, and the development of new trading centres, which has been stimulated by the great improvement in communications effected in recent years. There are still, however, in the whole of India only twenty-nine cities with a population (including military cantonments adjoining) of not less than 100,000 inhabitants, compared with thirty-nine in England; and their aggregate population is not much more than one-fiftieth of that of the whole country, whereas in England it is one-seventh. Some of the Indian cities, such as Mandalay and Patna, which grew up under an entirely different set of political and commercial conditions, are declining, while others of later origin, or which have benefited by recent

[1] That is to say, where the people live in settled villages. The great majority of the inhabitants on this wild frontier are nomadic.

industrial and commercial developments, are growing rapidly. Of the newer cities, the most extraordinary progress is shown by Rangoon, the population of which has increased in thirty years from less than 100,000 to nearly a quarter of a million. The growth of Karāchi is only less notable than that of Rangoon; while among inland towns that have prospered through manufactures, Cawnpore and Ahmadābād may be mentioned. It is impossible within the narrow limits of the present chapter to discuss this subject at all fully, but we may consider briefly the statistics for the three great Presidency cities. The population of each of the other principal towns, and its increase or decrease since 1891, will be found in Table V (p. 492).

Calcutta. Calcutta was founded by Job Charnock, who, about 1686, occupied on behalf of the East India Company the three villages which then existed on its site. The population of the settlement in 1710 was only 10,000 or 12,000; but it grew rapidly, and by the middle of the eighteenth century it was estimated to be about 200,000; it was probably about 400,000 in 1850, and in 1872 the first actual enumeration showed it to be 633,009[1]. In 1901 it had risen to 847,796, exclusive of 101,348 persons in areas which are structurally an integral part of Calcutta though outside the jurisdiction of the Calcutta municipality, and also of 157,594 in Howrah, which lies along the opposite bank of the Hooghly and is as much a part of Calcutta as Southwark is of London. With these additions, the capital of India contains a population of 1,106,738, and takes a place among the twelve largest cities of the world. The average number of inhabitants per acre is forty-one, but it rises to sixty-eight if we exclude the cantonment of Fort William and the extensive *maidān* adjoining: in the three most crowded wards it ranges from 201 to 281. Barely one-third of the residents of Calcutta claim it as their birthplace; the others are immigrants, of whom the vast majority are divided in almost equal proportions between natives of adjacent Districts and Cuttack on the one hand, and of Bihār and the United Provinces on the other. The males outnumber the females in the ratio of two to one.

Bombay. The population of Bombay was about 10,000 in 1661, when its possession passed from Portugal to England by the marriage treaty between Charles II and Catherine of Braganza; fourteen years later it had risen to about 60,000; and in 1836 it was

[1] This is the population, at that time, of the whole area now included within municipal limits.

estimated to be 236,000. In 1872 it was 644,405, and in 1891, 821,764; but in 1901 it had fallen, owing to the ravages of plague, to 776,006. The greater part of this decrease of 6 per cent. is, however, believed to have been due, not to a permanent reduction of the population, but to the temporary departure of many of the regular inhabitants owing to fear of the plague which was raging at the time of the Census[1]. The average number of inhabitants per acre is fifty-one, but in the most congested tracts in the heart of the city it rises to nearly 600. Three-quarters of the inhabitants are immigrants, of whom a quarter come from the neighbouring District of Ratnāgiri and about the same number from Poona and Sātāra taken together: as compared with Calcutta the number who come from distant parts is small. Only 38 per cent. of the population are females.

Madras.

Madras, with 509,346 inhabitants in 1901 against 397,552 in 1871, ranks next to Calcutta and Bombay, but is of much smaller industrial and commercial importance. There are, on an average, twenty-nine persons per acre; males and females are almost equal in number; and one-third of the people are immigrants, mainly from other parts of the Presidency.

Houses and house room.

The houses found in India differ greatly from those of England. In England a single building contains at least one family and sometimes several; but in India it more often happens that the same family occupies several buildings and, so far as the manner of occupation is concerned, the enclosure within which the buildings are arranged corresponds to the English 'house' more closely than do the buildings themselves. In some parts of India, therefore, the term 'house' was defined for census purposes as the enclosure, without reference to the question whether the buildings within were occupied by one family or by several; but in Bengal, the United Provinces, Burma, and Assam the social aspect was held to be of primary importance, and a 'house' was defined as 'the residence of a commensal family.' It might be anticipated that the variations in the definition would greatly affect the average number of persons per house. This, however, is not the case: the number is high in the Punjab and Kashmīr (6 per house and upwards, compared with a general mean of 5·2), but elsewhere it is generally very uniform; and the figures for Bombay and Madras, where the 'enclosure' criterion was adopted, differ scarcely at all from those for Bengal and Burma, where the

[1] A special enumeration, taken on the night of February 9, 1906, returned the population of Bombay city at 982,000.

'family' was the standard. The inference is that, except in Northern India, the enclosure is generally the residence of a single commensal family.

Growth of population.

We have hitherto been dealing with the state of things disclosed by the Census of March, 1901. Let us now consider the statistics with reference to the changes which have taken place since the first systematic attempt to ascertain the population of the Indian Empire, which was carried out between the years 1867 and 1872. This pioneer enumeration was admittedly very rough and imperfect, and many of the Native States were left out of the count. The first synchronous Census on the modern system[1] was taken in February, 1881: the operations extended to the whole of India, as the term was then understood, except Kashmīr and various small remote tracts, and a much higher standard of accuracy was arrived at. February, 1891, witnessed the third decennial Census, which included within its scope Upper Burma and several other newly acquired tracts and, in point of accuracy, left nothing to be desired, save perhaps in a few of the wilder and more inaccessible tracts. The population disclosed by each enumeration is shown below; but it must be remembered that these figures make no allowance for the inclusion of new areas within the scope of the operations, or for the artificial changes due to better arrangements:—

Date of Census.	Population.	Variation per cent. since previous Census.
1867 to 1872	206,162,360	. .
1881	253,896,330	+ 23·1
1891	287,314,671	+ 13·1
1901	294,361,056	+ 2·4

It is estimated in the Census Report for 1901 that between the years 1872 and 1881 there was probably no real growth of population, and that in any case it did not exceed 1·5 per cent.;

[1] Under this system the whole country is divided into blocks containing about forty-five houses, each of which is in charge of an enumerator who enters beforehand in his schedules full details for each person ordinarily resident in his block. Except in the more remote areas, where the final revision is effected in the daytime or, in exceptional cases, is dispensed with altogether, this preliminary record is corrected on the night of the Census with reference to the persons then actually present, absentees being struck out and new-comers entered in the schedules. The work is checked at all stages by a regular chain of supervising officers. Further details will be found in the Introduction to the *India Census Report* for 1901.

for the next decade the true increment is placed at 9·8 per cent.; and for that preceding the Census of 1901 at 1·5 per cent., this last figure being the resultant of an increase of 3·9 per cent. in British territory and a decrease of 6·6 per cent. in the Native States. The first of the above periods included the disastrous years 1876–8, when famine conditions prevailed over a great part of the Peninsula, reaching a climax in Mysore, which is estimated to have lost a quarter of its population, while there were several less severe famines, such as that in Bihār in 1874. The next decade (1881–91) witnessed a succession of exceptionally good seasons, and the population grew rapidly, as it always does after a set-back resulting from a catastrophe like famine, which causes a high mortality among the very old and very young, and among persons suffering from infirmities or otherwise of enfeebled physique, while healthy persons in the prime of life sustain a comparatively small diminution in their numbers. The birth-rate is thus not permanently affected, while the mortality for the next few years is exceptionally low, owing to the disappearance during the famine of a very large proportion of those who would otherwise have succumbed at a somewhat later date.

Conditions affecting growth of population, 1891–1901.

It is a matter of common observation that good seasons and bad go in cycles, and the succession of prosperous years between 1881 and 1891 was followed by a series of lean ones in the ensuing decade. In 1891–2 there was scarcity over a considerable area in Madras and Bombay, and in parts of Bihār. In 1895 a weak monsoon led to extensive crop-failure in the southern Districts of the United Provinces; and a sudden cessation of the rains of 1896 resulted in famine over an area of about 307,000 square miles with a population of nearly 70,000,000: on the average 2,000,000 persons were relieved daily during the twelve months from October, 1896, to September, 1897, and the number rose to more than 4,000,000 at the time of greatest distress. In 1899 the monsoon again failed, and the results were even more disastrous, for though the population affected was slightly less than in 1896–7, famine conditions prevailed over an area half as great again and with less easy means of communication; the drought was much more severe; the people had not yet recovered from the previous visitation; the mortality among cattle from want of fodder and water was far heavier; and the most seriously affected tracts lay for the greater part in Native States, where the relief organization was less perfect than in British territory. In the height of this famine there were for weeks together more than 6,000,000

persons in receipt of relief. On a comparison of the Census figures of 1901 with those of 1891, it is estimated that during these two famine periods the death-roll exceeded the normal mortality of non-famine years by about 5,000,000, of which the greater portion occurred in the Native States. But only a small proportion of this abnormal mortality was due to actual starvation. Most of it was caused by fever, cholera, and other epidemics, which are always unusually prevalent and fatal in times of drought and scarcity. Their prevalence at these seasons is due to the pollution of the scanty water-supply, and to the collection of large bodies of people on relief-works, and also to insufficiency of proper food, which, though not resulting in starvation, is serious enough to reduce the resisting power of the population to attacks of disease. The diminished vitality of the people led also to a heavy fall in the birth-rate, but this was to some extent counterbalanced by an unusually high rate of reproduction when the people had recovered their normal condition.

Another adverse circumstance of this decade was the plague epidemic which, commencing in Bombay city in September, 1896, had caused a mortality of at least three-quarters of a million by the date of the last Census. That a period which witnessed two of the greatest famines of the century, and the appearance of a new and deadly disease, should have shown any growth of population is due partly to the efficiency of the famine relief operations, and partly to the remarkable commercial and industrial progress which is now taking place—the construction of railways, the extension of irrigation, the spread of tea and jute cultivation, the development of the coal-mines of Bengal and the gold-fields of Mysore, the opening of jute and cotton mills, and other similar undertakings, which have added to the general prosperity of the country and created many new forms of employment for the great class of landless labourers. As already mentioned, the famine administration was far more efficient in British territory than in the Native States, and it is mainly in British territory that the great industrial development described above has taken place.

Capacity of India to support a greater population.

With this steady growth of population in a country which already contains one-fifth of the world's inhabitants, the question arises whether the time is not approaching when it will have more inhabitants than it can support; but an examination of the facts shows no cause for alarm at present. Apart from the non-agricultural forms of employment which, as we have seen, are rapidly growing in importance, it seems certain

that, even in the most crowded tracts, more scientific farming would greatly increase the present produce of the soil. There are, besides, many parts, e.g. Burma, where, even under present conditions, ample scope remains for expansion; and many others, such as Western Rājputāna, where, with the aid of irrigation, crops might be grown on what is now a sandy desert. Overcrowding, moreover, is a purely relative term, and the densely inhabited Districts of Eastern Bengal form one of the most progressive and prosperous tracts in the Empire. In India, as a whole, the greatest growth of population since 1891 has occurred in Districts which in that year had already a density of from 500 to 600 persons per square mile.

Details for principal Provinces. Assam.

In Assam about half the increase of 12 per cent. during the ten years preceding the Census of 1901[1] is accounted for by the inclusion of Manipur and South Lushai, which were not dealt with at the previous enumeration. A great part of the remainder is due to the immigration of coolies to the tea gardens, and the foreign-born population has risen from one-half to three-quarters of a million. The most rapid progress is shown by the two great tea Districts of Upper Assam, Lakhimpur and Sibsāgar, which have added 46 and 24 per cent. to their population since 1891: the former now contains three times the number of inhabitants recorded in 1872. Lower down the Brahmaputra valley the obscure fever epidemic known as *kalā azār* has caused an appalling mortality—Nowgong District has lost 25 per cent. of the population recorded in 1891, and Kāmrūp 7 per cent.; but there are signs that the force of the epidemic is slackening, and when it disappears a rapid recovery may be anticipated. The immigrants imported for the tea gardens show a growing tendency to settle down permanently as cultivators on the expiration of their garden contracts.

Bengal.

The great Province of Bengal has a recorded increase during the decade 1891–1901 of nearly 4,000,000, or 5·1 per cent. Among the natural divisions of the Province, East Bengal comes first with an increase of 10·4 per cent.; Chotā Nāgpur has 7·8; West Bengal and Orissa, 7; North Bengal, 5·9; and Central Bengal, 5·1 per cent. In North Bihār the population is virtually stationary, and in South Bihār it has declined 3·6 per cent. East Bengal enjoys a copious and regular rain-

[1] For details of increase or decrease by Provinces, &c., see Table III (p. 490). In the present sections the figures for each British Province include those of its dependent Native States, and Baluchistān is not dealt with, as it was enumerated for the first time in 1901.

fall; the fertility of the soil is renewed every year by fresh deposits of silt, brought down by the Ganges and the Brahmaputra; the climate is, on the whole, a healthy one; and the people have profited greatly by the rise in general prices and the introduction of jute cultivation. The gain in Chotā Nāgpur would have been much larger but for an enormous amount of emigration to Assam and North Bengal. The figures for West and Central Bengal are the net outcome of a decline, or a merely nominal increase, in low-lying tracts where the drainage is defective and malaria is prevalent, and of a comparatively rapid advance in the neighbourhood of Calcutta and the Burdwān coal-fields, which attract numerous immigrants from elsewhere. Famine prevailed in North Bihār in 1897; but the stationary condition of this tract is due to the unhealthiness of its *tarai*, and the prevalence of plague in Sāran District, rather than to famine losses. Plague is also the main cause of the decadence in South Bihār, which is greatest where the epidemic was most virulent.

The Bombay Presidency was hard hit by the famine of 1876–8, and its population was very little larger in 1881 than it had been in 1872. During the next decade the increase was 15 per cent.; but between 1891 and 1901 there were frequent and severe outbreaks of plague, causing a total mortality of from one-half to two-thirds of a million persons, as well as two famines, with the result that the Census of 1901 showed a net decrease of 5 per cent., the resultant of a loss of 1·6 per cent. in British territory and of 14·5 per cent. in the Native States. Taking the main divisions of the Presidency, Sind relies on irrigation and is largely independent of the rainfall; and the extension of its canal system, coupled with the opening of new railways and greater facilities for immigration, has resulted in a gain of nearly 12 per cent. A moderate improvement was recorded in the Konkan (or coast) Districts, and the Carnatic (inland southern) Districts showed only a nominal decrement; but in the Deccan, where the famine of 1897 was most severe, there was a decline of 4·3 per cent. Gujarāt, which bore the brunt of the famine of 1900, had a loss of 13 per cent. in British Districts: its Native States suffered even more severely, the loss in some cases amounting to a quarter, and even a third, of the population recorded in 1891. Bombay.

Upper Burma was annexed in 1886, and the census figures for the two earlier enumerations refer only to Lower Burma, the population of which was returned at 2,747,148 in 1872. But apart from the addition of new territory, the rate of growth has Burma.

been very rapid, amounting, in the case of Lower Burma, to 24½ per cent. in the decade 1881–91, and 21 per cent. in the ensuing ten years. The corresponding rate for Upper Burma during the latter period is 17½ per cent.; but it falls to 11 per cent. if we exclude from the comparison the figures for several Districts where the count of 1891 is believed to have been defective. Emigration accounts for all or most of the difference between this rate and that recorded for Lower Burma. Burma is perhaps the most prosperous and progressive of all the Provinces, and much has been done in recent years to develop its resources. A few Districts in Upper Burma were slightly affected by famine in 1896–7, but Lower Burma escaped, and was one of the principal granaries whence the needs of other parts of India were supplied. The immigrants from outside the Province (about 475,000) are more numerous by nearly 50 per cent. than in 1891, and the quantity of rice exported has risen in the same proportion. Cultivation has extended enormously, especially in the great rice-growing Districts in the Irrawaddy delta.

Central Provinces. The Census of 1881 disclosed an increase of 24 per cent. in the population of the Central Provinces, including Berār, but much of this was due to defective enumeration in 1872, especially in the wild and sparsely inhabited Native States. In 1891 the total population stood at 15,842,296, representing a further advance of 11·4 per cent. Then followed a succession of bad seasons, culminating, in 1896–7, in the first great local famine since the commencement of British rule, which was followed, after a single year's respite, by the widespread calamity of 1899–1900. Epidemics of cholera prevailed in seven years of the period, and malarial fever was unusually rife and severe. These disasters, coming upon a weakened and impoverished people, reduced their number in 1901 to a figure less by 8 per cent. than that recorded ten years previously. The weakest suffered most, and the resourceless, suspicious, and improvident aboriginal tribes sustained a far greater diminution than the Hindus, among whom again the low castes suffered more than the high. The age statistics show that the mortality was highest among the very old and the very young, and that the decrease in the number of persons at the reproductive ages has been very slight. A rapid recovery from the losses of this disastrous decade may therefore be looked for; and, should no fresh calamity intervene, the population in 1911 will probably be found to exceed considerably that recorded in 1891.

Madras. Between the years 1871 and 1901 there was, according to

the Census, a net increase in the population of the Madras Presidency of close on 23 per cent. In the first of the three decades, which witnessed the disastrous famine of 1877–8, the returns showed a fall of nearly one per cent., and this would have been far greater but for the imperfection of the enumeration of 1871. The next decade was a period of good seasons and recovery from famine losses, and the population grew by 15 per cent., the gain being greatest in the Districts which had suffered most from the famine. The ten years ending in 1901 yielded a moderate increase of 7·8 per cent. Though there was no actual famine during this decade, there were three years of scarcity, and extensive emigration took place, especially to Ceylon and Burma, the net loss by the ebb and flow of population being estimated at 858,000, compared with 550,000 in 1891: there were also a few small outbreaks of plague.

Punjab and the North-West Frontier Province.

The Native States of the Punjab were enumerated for the first time in 1881. In that year the population of the British Districts of the Punjab, including the present Frontier Province, was greater by 7·1 per cent. than that recorded at the previous enumeration of 1868. The natural rate of increase during this period had been checked by two famines; but the next ten years were years of prosperity and recovery, and the Census of 1891 showed a gain of 10·7 per cent., to which British and Native territory contributed in equal proportions. In 1901 there was a further advance of 7 per cent., the net outcome of an increase of 14·4 per cent. in the Frontier Province, of 6·9 per cent. in the Punjab proper, and of 3·8 per cent. in the Native States. Famine prevailed in 1897 and 1900, chiefly in the south-eastern Districts, but the consequent mortality was small. On the other hand, there was a great development of irrigation, especially in that derived from the Chenāb river, whereby an area of more than 3,000 square miles has been transformed from a barren waste into one of the most fertile wheat-producing tracts of Northern India, and a scanty population of pastoral nomads has been replaced by settled cultivators numbering more than three-quarters of a million. There has also been a rapid growth of mill industries, fostered by the cheaper fuel now obtainable from the Bengal coal-mines.

United Provinces.

Oudh was annexed in 1856, and a Census was taken in 1869. The population then recorded, combined with that of the Province of Agra, according to the enumeration of 1872, showed an increase of 5·3 per cent. in 1881. This was followed by an

advance of 6·2 per cent. in 1891, and of 1·7 in 1901. In the first of these three periods the recorded rate of growth was exaggerated by the relative incompleteness of the earlier enumerations, and real progress was retarded by the famine of 1877–9. During the next ten years the seasons were good and the increase was real. After 1891 the Provinces suffered from a succession of bad harvests, culminating in widespread famine in 1897; the efforts made to alleviate the distress were, however, successful in preventing serious loss of life. The heavy rainfall of the earlier years of this decade led to severe epidemics of malarial fever which, in 1894, not only raised the death-rate to an exceptional height, but so sapped the vitality of the people that the number of births in 1895 was abnormally small. The resources of these Provinces seem insufficient, under present conditions, for the support of the whole population, and for many years past large numbers of the inhabitants have been seeking a livelihood elsewhere, especially in the lower part of the Gângetic delta. The number of these emigrants had reached 1½ millions in 1901, when the net loss by migration was approximately 830,000 compared with 571,000 ten years previously. These figures are exclusive of emigration to the West Indies, Natal, and Fiji, which caused a further net loss during the decade of about 100,000, and also of that to Nepāl, for which no accurate information is available.

Native States. Many of the Native States were omitted from the scope of the earlier enumerations, and even where they were included the operations were not carried out with the same degree of accuracy as in British territory, and the results are less reliable. No useful purpose would therefore be served by considering the variations in their population prior to 1891. It will suffice to say that they are for the most part sparsely inhabited, and that in normal times a fairly rapid growth of population may be expected. The famines of the last decade fell with the greatest severity on many of these States, and the Census of 1901 thus showed a net decrease, as compared with its immediate predecessor, of 5·4 per cent., or of 6·6 per cent. if we exclude the artificial gain due to the enumeration of new areas. The results for the States in political relation with Local Governments have already been discussed under the Provinces to which they are attached. Among those which are directly under the Government of India, the loss was greatest in the tracts chiefly affected by the crop failure of 1899, viz. Baroda and the States of Rājputāna, where nearly one-fifth of the population counted in 1891 had disappeared; and those of

Central India, where the decrease represented about one-sixth of the former population. Hyderābād was less seriously afflicted, and the falling off there was only 3·4 per cent. Mysore, which enjoyed a practical immunity from famine, and benefited by the rapid development of the Kolār gold-fields and the consequent general expansion of trade and industrial activity, has added 12 per cent. to its population. Kashmīr, which shows an increase of 14·2 per cent., also lay for the most part outside the famine zone, and its inhabitants have profited by settlement operations and the concomitant improvements in the general administration.

Migration—(a) Internal.

Owing partly to their conservatism and dislike of change, and partly to the disadvantages which the caste system imposes on Hindus when separated from their own social group, the people of India are very disinclined to leave their homes, and at the time of the last Census more than nine-tenths of them were resident in the Districts where they had been born. Even of those who were enumerated elsewhere, the great majority were found only a very short distance from their original home and were not emigrants in the ordinary sense of the term. The volume of movement to a distance is, generally speaking, very small (see Table XI, p. 497), but there are several notable exceptions. The great tea industry of Assam has created a demand for labour which the local supply is wholly unable to satisfy, and the planters are thus forced to seek for coolies elsewhere. The consequence is that Assam contains three-quarters of a million immigrants, or one-eighth of its total population. These belong for the most part to the hardy aboriginal tribes of the Chotā Nāgpur plateau in Bengal and the adjacent parts of the Central Provinces and Madras; and, on the expiry of the labour contracts which they execute on coming to the Province, large numbers settle down as cultivators, or as carters, herdsmen, and petty traders. The drain from Bengal to Assam is almost counterbalanced by an influx of nearly half a million natives of the United Provinces, who come to seek employment in the mills of Calcutta and Howrah and the coal-mines of Burdwān, and as earth-workers, palanquin-bearers, and field-labourers all over Bengal proper, where the indigenous inhabitants are too well off to be willing to serve for hire. Some of these immigrants stay only for the winter months, while others remain for a number of years; but few become permanent settlers. In Burma, as in Bengal, the profits of cultivation are so great, and the amount of waste land is so enormous, that very few labourers are available

locally, and the Province is dependent on outsiders for its harvesters and for the workmen in its rice-mills. These aggregated nearly half a million at the time of the last Census, about three-quarters of whom were natives of Madras and Chittagong. More than five-sixths of the total number were males: most of these return home when the harvest and milling seasons are over, but a few settle down permanently as cultivators or traders. Although separately administered under the Colonial Office, Ceylon is geographically a part of India, and its tea gardens depend for their labour force on Tamil coolies recruited in Madras. The total number of Indian immigrants in 1901 was 436,662, compared with 264,580 ten years earlier; but few of them had become domiciled in the island.

In addition to these movements from one Province to another, there are occasional instances of considerable migration within the limits of the same Province. Thus, in Bengal, more than half a million natives of Bihār were enumerated in Bengal proper, whither they had gone in search of labour like the immigrants from the United Provinces already referred to. The aboriginal tribes of the Chotā Nāgpur plateau are spreading to the north-east, and are bringing under cultivation the desolate uplands of the Bārind, while large numbers of them have gone to the tea gardens of Jalpaigurī, whither they find their way without the help of the elaborate recruiting agency on which the Assam tea gardens depend. Again, between three and four hundred thousand persons born in Upper Burma were found in Lower Burma at the Census.

The statistics of birthplace collected at the Census afford no clue to the causes of migration, nor are merely temporary movements distinguished from those of a permanent nature. It would appear, however, that the various modern industrial undertakings, such as tea and coffee cultivation, coal and gold mines, jute and cotton mills, form the main incentives to migration properly so called. It has been pointed out above that a very large proportion of the inhabitants of the cities of Calcutta and Bombay have gone thither from other parts of the country, and the same is the case, to a greater or less extent, with all the large centres of modern trade and industrial enterprise. Irrigation is also a frequent cause of migration, and we have already seen how the barren waste of the Rechna Doāb in the Punjab has received, through the Chenāb Canal, a population of three-quarters of a million in the short space of ten years. A generation earlier the opening of canals in

the old Sirsa District, now amalgamated with Hissār, caused the population to double in less than thirty years. Similarly, the irrigation works on the Kistna river in Madras have attracted many settlers from the surrounding Districts. The minor movements of the people, or casual migration, depend largely on their marriage customs which, in the case of Hindus, tend to make a man choose his bride from some other village. There are also, at certain seasons, considerable local movements among the landless labourers, and the harvesting of an important crop attracts large numbers of persons of this class from other parts where there is at the time less demand for their services. Lastly, there is during the cold season (i. e. at the time of year when the Census is taken) a great deal of travelling to attend important religious festivals or fairs, or to visit friends and relations and take part in weddings and other social ceremonies.

(*b*) External.

The above remarks refer to what is known as internal migration, i.e. to the movements of the people between different parts of India, including Ceylon. It remains to give some account of external migration, or the ebb and flow of population between India and other countries. The influx of foreigners shows a steady increase, and at the Census of 1901 they aggregated 641,854 against 408,572 twenty years previously. About 526,000 were Asiatics, the most important contribution being one of nearly a quarter of a million from Nepāl, of which number more than half consisted of settlers from the other side of the common boundary, who had married or taken up land in the contiguous British Districts and had been (presumably) replaced in Nepāl by emigrants from our side of the frontier. The hills of Nepāl, moreover, are an important recruiting ground for the Indian Army; and on January 1, 1901, there were about 13,000 'Gurkhas' in the regular army and 6,000 more employed in the military police, or as porters and the like. The next largest item is that of immigrants from Afghānistān. In 1901 these numbered about 116,000, of whom all but 27,000 were found in the Punjab; of the remainder, a large number are itinerant dealers who ply their trade all over Northern India during the winter months. Of the other Asiatic immigrants it will suffice to mention the Chinese (47,000), whose head-quarters are in Rangoon and Calcutta; and the Arabs (33,000), who are found mainly in the Bombay Presidency and in Hyderābād. Of the non-Asiatic immigrants, who number 104,583, the United Kingdom supplies 96,653 (81,990 males and 14,663 females), Africa 8,293,

America 2,069, Germany 1,696, France 1,351, and Italy, 1,010. In 1891 the natives of the United Kingdom numbered 100,551: the decrease at the last Census is due to the absence in South Africa of a portion of the British troops ordinarily stationed in India, and the consequent reduction of the European garrison to 60,965 as compared with 67,077 in 1891. Most of the natives of Africa were enumerated in Aden.

It is impossible to give accurate figures showing the emigration from India. There is no information whatever regarding the number who are resident in Nepāl, Afghānistān, Tibet, and Bhutān, and the estimate of 208,000 shown in the Census Report is admittedly a mere guess. The number of natives of India living in Europe is inconsiderable and may be left out of account. For the Colonies mentioned below we may, in the absence of other data, take the figures noted against them, which represent the Indian coolie population returned by the local Protectors of emigrants as resident there in 1900:—

British Guiana	125,875
Trinidad	85,615
Mauritius	265,163
Natal	65,925
Fiji	15,368
Jamaica	15,278
Surinam	18,000
St. Lucia	1,200
Martinique	3,764
Guadeloupe	15,276
Total	611,464

The returns showing the number of Indian labourers going to and returning from Uganda indicate that about 26,000 were actually there at the time of the 1901 Census. It was estimated in 1898 that there were at that time 5,000 natives of India in the Transvaal, and a year later the number in Cape Colony, Basutoland, and South Rhodesia was reported to be 3,913; there are believed to be about 10,000 in Zanzibar; and the Census of 1891 disclosed about 15,000 in Australia and New Zealand. For all these places combined we may place the total at 35,000. Including those to Ceylon and the Straits Settlements, the aggregate number of emigrants would thus appear to be about 1,374,000, or more by 732,000 than the number of immigrants counted in India on March 1, 1901. The adverse balance, though considerable by itself, forms a very small fraction of the total population, but it is possible that it may grow rapidly at no very distant date. The demand

for labour in South Africa is great and urgent; and if the difficulties which at present stand in the way of its being met by emigration from India could be removed, it is probable that Indian coolies would flock thither in large numbers. The opening out of the Ceylon jungles, and the repairing of the old irrigation works which they contain, may similarly be expected to lead to the settlement in that island of large numbers of cultivators from the more congested tracts of Southern India. At the present time the most noteworthy foreign labour markets are Mauritius, where there are more than a quarter of a million Indian coolies, chiefly on sugar plantations, and British Guiana, where the number is approximately an eighth of a million. The persons for whom these coolies are recruited are required by law to repatriate them on the expiry of the term for which they are engaged, if they wish to return to India.

Of the total population of India, 70 per cent. were returned at the last Census as Hindus, 21 per cent. as Muhammadans, 3 per cent. as Buddhists, 3 per cent. as Animists, and 1 per cent. as Christians, the balance being made up of Sikhs, Jains, Pārsīs, Jews, and others (see Table VI, p. 493). It is very difficult in practice to distinguish between Hinduism and some of the other indigenous religions of India[1]. Many of the aboriginal tribes are hovering on the outskirts of Hinduism, and it is impossible to define at what precise point a member of one of these tribes should be classed as a Hindu. The procedure in individual cases thus depended on the personal predilections of the enumerators and the varying extent to which, in different parts of India, ceremonial uncleanness is held to conflict with a man's claim to be considered a Hindu. Jainism, again, is generally recognized as a distinct religion; but in certain parts the Jains themselves strongly assert their claim to be Hindus, and some of them were doubtless thus entered at the Census. The same may have been the case with certain sections of the Sikhs, and also with some of the Himālayan Buddhists; but in Burma, where the members of this latter persuasion are mainly found, the figures may be accepted as reliable. There is also no reason to doubt the accuracy of the return for Muhammadans and Christians, as in their case there is little room for doubt or misdescription. Religion.

Hinduism, with its 207 million votaries, is *the* religion of Hindus.

[1] For a discussion of the practical criteria by means of which Hinduism may be distinguished from other religions indigenous to India, see *India Census Report* for 1901, paragraphs 634 and 661.

India. It is professed in one or other of its multifarious forms by seven persons out of every ten; and it predominates everywhere except in the more inaccessible tracts in the central highlands and on the eastern outskirts, where it has hitherto failed to absorb the earlier faiths of the rude aborigines or the rival doctrines based on the teaching of Sākya Muni, and in certain other tracts where it has been forced to yield to the attacks of Muhammadanism and Christianity. Its position is strongest in Orissa, Mysore, and Madras, where it is professed by nine-tenths of the population; and in Bihār, Bombay (excluding Sind), the Central Provinces, the United Provinces, and the Agencies of Central India and Rājputāna, in all of which tracts the proportion exceeds four-fifths. The smaller proportions elsewhere are explained by the greater prevalence of other religions, e.g. of Buddhism in Burma, of Muhammadanism in the north-west of India and in Eastern Bengal, and of Animism in the hill tracts of Assam. The number of persons returned as Hindus in 1901 was less by half a million than it was ten years previously, and the proportion borne by them to the total population has also declined. This is due mainly to the circumstance that, generally speaking, the tracts where Hindus preponderate were those that suffered most from famine, but there are also other causes at work. The gains from the ranks of the Animists are probably exceeded by the losses on account of conversions to Muhammadanism and Christianity; and the social customs of the Hindus, especially the prevalence of infant marriage and the prohibition of the remarriage of widows, tend to diminish their reproductive capacity as compared with the adherents of other creeds.

Animists. According to the census returns, the total number of Animists in India slightly exceeds $8\frac{1}{2}$ millions, of whom nearly one-third are found in Bengal, more than one-fifth in the Central Provinces, one-eighth in Assam, one-ninth in the Central India Agency, and one-thirteenth in Madras; the only other tracts with a number exceeding 100,000 are Rājputāna, Burma, and Baroda. In Assam and the Central Provinces the Animists form between one-sixth and one-seventh of the total population; in Central India they exceed one-ninth, and in Baroda one-eleventh. In Bengal the general proportion is only one in twenty-nine, but in some parts it is much higher, and in two Districts of Chotā Nāgpur it is nearly one in two. In Madras also the distribution is very uneven, and nearly all the Animists are congregated in two Agency tracts in the north.

Excluding the outlying parts of Assam and Burma, it may be said that the amorphous congeries of pre-Hindu religious ideas which, for want of a better nomenclature, were classed together in the census returns under the title of Animism[1], have disappeared from the open plains of India. The stream of Aryan immigration followed the downward course of the great rivers, the Ganges and the Indus, and gradually spread over the plains and along the coast. The earlier inhabitants of the open country were either subjugated or brought peaceably under the spell of Hinduism, and it is only in the less accessible hills and forests that they have preserved their ancient tribal organization and language and the religious beliefs of their ancestors. Even here the influence of improved communications is making itself felt; the tribal dialects are gradually being replaced by Aryan languages; and the tribal beliefs are giving way before the direct onslaughts of Christian missionaries and the more insidious, but none the less effective, advances of Hinduism. But it is impossible, for the reasons already given, to ascertain from the census figures the rate at which the process of decay is proceeding.

Buddhists, Sikhs, and Jains.

Of the other indigenous religions the most important numerically is Buddhism, with about 9½ million followers, of whom all but a very small minority are found in Burma or on its confines: the remainder are Himālayan Buddhists, of Tibetan or Nepālese origin. The Sikhs, who slightly exceed two millions, are practically confined to the Punjab, while the Jains, with 1⅓ millions, have their head quarters in Rājputāna and Gujarāt A small sprinkling of Jains are found in the adjacent country to the south and east, but none among the natives of Bihār where the religion had its origin.

Modern offshoots of Hinduism.

Hindu sects form a vast array; but the statistics collected at the Census regarding these are incomplete, and it must suffice to mention two monotheistic sects of recent origin, the founders of which clearly drew their inspiration from Western thought—the Brahmo Samāj, founded in Bengal by a Brāhman, Rājā Rām Mohan Roy, who died in England in 1833; and the Arya Samāj, founded by Dayānand Saraswatī of Kāthiāwār, also a Brāhman, whose missionary work commenced in the

[1] Animism may be defined roughly as the belief that man is surrounded by a multitude of vaguely conceived spirits or powers, some of which reside in rocks and streams and other natural objects, while others preside over disease, and others, again, have no special function or habitation. They are for the most part malignant, and require to be propitiated by offerings and ceremonies in which magic plays an important part.

United Provinces about 1860. In 1901 the latter sect had over 92,000 professed adherents, of whom 71 per cent. were in the United Provinces and 27 per cent. in the Punjab. It is recruited almost wholly from the educated classes, chiefly of the Kāyasth and Khattrī castes; the number of its adherents is growing apace, and showed an increase of 131 per cent. in the decade preceding the last Census. The progress of the Brahmo Samāj, which is supported chiefly by the Brāhmans, Kāyasths, and Baidyas of Bengal, is far less rapid, and in 1901 only 4,050 persons were returned as belonging to it, against 3,051 in 1891. This slow growth seems attributable partly to the circumstance that many Brahmos returned themselves as Hindus, and partly to the greater latitude of thought and action allowed by modern Hinduism, especially in the larger towns.

Musalmāns.

The total number of Muhammadans is 62½ millions, or rather more than a fifth of the total population. Of these 25½ millions, or 41 per cent., are in Bengal; 14 millions, or 22½ per cent., in the Punjab and Frontier Province; and 7 millions, or 11 per cent., in the United Provinces. Bombay contains 4½ millions, Madras 2¾, Kashmīr 2⅙, Assam 1¾, and Hyderābād 1⅐ millions. In proportion to the total population, Islām is most strongly represented in Kashmīr, where it is the religion of 74 per cent. of the inhabitants; then follow the Punjab with 53 per cent., Bengal with 32, Assam with 26, Bombay with 18, and the United Provinces with 14 per cent. The proportions, however, vary greatly even within the same Province; and in Bengal nearly half the aggregate is found in the eastern tract, where two-thirds of the inhabitants are followers of the Prophet, compared with only 4½ per cent. in Chotā Nāgpur and 2½ per cent. in Orissa. In Bombay nearly three-fifths of the total number of Musalmāns are in Sind; in Assam two-thirds are in the single District of Sylhet; and in Madras one-third are in Malabar. It is easy to understand why Muhammadans should be found in large numbers in the Punjab and Sind, which lie on or near the route by which successive hordes of Afghān and Mughal invaders entered India; but it is not at first sight apparent why they should be even more numerous in Bengal proper. The reason is that in the east and north of this tract, where the Muhammadans are most numerous, the bulk of the inhabitants had not been fully Hinduized at the time of the Muhammadan conquest, and were thus more easily brought under the influence of Islām. It is difficult to apportion the result between the peaceful persuasion of Musal-

mān missionaries and forcible conversion by fanatical rulers, but probably the former had the greater influence. That conversion at the sword's point was by no means rare is known from history, but that its influence alone cannot make very many converts is shown by the fact that, in spite of Tipū Sultān's ferocity towards 'infidels,' Mysore to this day contains an exceptionally small proportion of Muhammadans.

The increase in the number of Muhammadans during the last decade was nearly 9 per cent., or about four times that of the population at large. The tracts where they are mainly found escaped the stress of famine; but this is not the only explanation, and almost everywhere the statistics show that they are increasing more rapidly than their Hindu neighbours. Their girls are given in wedlock at a later age, and their widows are allowed to remarry, so that a larger proportion of their females of the child-bearing ages are married; their dietary is more nourishing; and in the absence of the various marriage difficulties which so often embarrass the Hindu father of a large family of girls, their female children are taken better care of than is often the case with the Hindus. The natural rate of increase is thus relatively high; the loss by conversion to other religions is insignificant; and there is a steady, though small, gain by accessions from the ranks of Hinduism.

The Christian community numbers 2,923,241, of whom 2,664,313 are natives and the remainder Europeans or Eurasians. Of the Native Christians, about two-fifths are Roman Catholics, and one-eighth Romo-Syrians, that is, Syrian Christians who accept the supremacy of the Pope, but conduct their services in Syriac and are allowed a special ritual; one-ninth belong to the Anglican communion; one-eleventh are Jacobite-Syrians; and one-twelfth are Baptists. Of the other sects, the best represented are the Lutherans and allied denominations, who claim 6 per cent. of the total, the Methodists with 2½ and the Presbyterians with 1½ per cent.[1] Christians.

Nearly two-thirds of the total number of Native Christians are found in the Madras Presidency and its dependent States. In Cochin and Travancore, where the Syrian Church has most

[1] The figures for the Anglican communion are swollen by the inclusion of 92,644 Protestants whose sect was not specified: two-thirds of these were returned from Travancore, where the majority were probably adherents of the London Mission. The figures for Roman Catholics proper are similarly inflated by the entry under this head of large numbers of Romo-Syrians who were not sufficiently precise in describing their sect at the Census.

of its adherents, nearly a quarter of the entire population profess the Christian faith. More than four-fifths of the Christians in Madras proper are found in the eight southern Districts, the scene of the labours of St. Francis Xavier, the later Jesuits, and Swartz: the great majority are here either Roman Catholics or Romo-Syrians. Elsewhere Christians are numerous only in Madras city, and in three Districts in the Telugu country, where the results are due mainly to Baptist missionary enterprise during the last thirty years.

Although it contains little more than one-seventh of the number enumerated in Madras, Bengal with 278,000 Christians, of whom 228,000 are natives, occupies the second place. But here, too, the distribution is extraordinarily uneven, and about half the Native Christians are found in one District of Chotā Nāgpur, Rānchī, where Lutheran, Roman Catholic, and Anglican missions are busily engaged among the aboriginal tribes: the Lutherans, who have been at work here since 1846, claim about half the total number of converts. In Bombay there are 220,000 Christians, including 181,000 natives, of whom nearly five-sevenths are Roman Catholics. The most important missions are those of the Roman Catholics in Thāna and North Kanara, of the Salvation Army in Kaira, and of the Church of England and the Congregationalists in Ahmadnagar. Burma contains 147,000 Christians: all but 18,000 are natives, and of these considerably more than half are Baptists, the majority being found in the Irrawaddy delta. The United Provinces have 103,000 Christians, of whom 69,000 are natives: the Methodists are here the most numerous, but the Anglican and Roman Churches are also well represented. In the Punjab there are 72,000 Christians, of whom, however, only 39,000 are natives of the country. The only other tracts which contribute in any marked degree to the total Christian population are Mysore and Assam, with 50,000 and 36,000 respectively, of whom 40,000 and 34,000 are natives.

As might be expected, the growth of Christianity is far more rapid than that of the general population. Its adherents have risen in number from 1,506,098 in 1872 to 2,923,241 in 1901, or from 1,246,288 to 2,664,313 if Native Christians alone be taken into account. That is to say, the Native Christian community has increased by 114 per cent. during this period. The degree of success attending missionary effort at the present day is even greater than would appear from these figures, as they include the adherents of the old Syrian Church, whose true strength far exceeds the 24 per cent. shown in the returns,

and which is not an actively proselytizing body. During the last decade the native members of the Anglican communion have added 26 per cent. to their numbers, the Baptists 15 per cent., the Lutherans 138, and the Methodists 139 per cent. The Salvation Army had a total of nearly 19,000 in 1901, against only 1,300 ten years previously. Since 1891 very rapid progress has been made by the Baptists of the Telugu country in Madras, the Lutherans in the Rānchī District of Bengal, and the Methodists in the west of the United Provinces.

Europeans and Eurasians.

The number of Europeans is returned as 169,677, compared with 168,158 in 1891, and that of Eurasians as 89,251, compared with 80,044. The apparently more rapid growth of the latter community is believed to be due, in part, to the greater success attained at the last Census in counteracting the tendency of Eurasians to describe themselves as Europeans. The same circumstance, coupled with the temporary absence in South Africa of a considerable number of the British troops ordinarily stationed in India, explains the very small increase among Europeans. The distribution of the European population depends to a great extent on the location of the British troops, who account for more than a third of the total, being most numerous in Northern India and least so in Bengal, Madras, and Assam. Excluding soldiers, Europeans are found mainly in the large cities: three-fifths of those enumerated in Bengal were residing in Calcutta and its environs, and nearly two-fifths of those of the Western Presidency and Burma were found in Bombay city and Rangoon. Eurasians are most numerous in Madras (26,209) and Bengal (20,893); next come Burma with 8,449 and Bombay with 6,899; and then Mysore and the United Provinces with between 5,000 and 6,000 each.

More than one-third of the persons returned as Europeans were born in India. The proportion falls to less than a quarter if we exclude children under fifteen, all of whom may be roughly assumed to have been born in the country; but it rises to two-fifths if we exclude the troops, who may similarly be assumed to be wholly British-born. By nationality ten Europeans in every eleven are British subjects: most of those owning allegiance to other flags are missionaries or members of foreign trading firms. By sect two-thirds of the Europeans are shown as members of the Anglican communion and one-fifth as Roman Catholics, while one-seventeenth were returned as Presbyterians. Of the Eurasians half are Roman Catholics and two-fifths are Anglicans; the majority of the remainder are either Methodists, Presbyterians, or Baptists.

Age. The people of India seldom keep count of their age, and their ideas on the subject are for the most part vague and inaccurate. It is thus impossible to place much reliance on this branch of the statistics collected at the Census. At the same time the official returns of births and deaths are so imperfect, and the other data on which to base an estimate of the mean duration of life and of the true birth and death-rates so meagre, that we cannot afford to neglect any source from which even an approximation to the actual facts may be deduced. Moreover, in a huge population like that of India, accidental mistakes tend to cancel one another, while the error due to the habit of plumping on favourite numbers can be eliminated by various methods of 'smoothing' or adjustment. Lastly, the degree of error may be assumed to be constant, and the data thus afford a basis of comparison between different periods and different parts of the country.

The mean age of the living at the time of the Census of 1901 is estimated in the Census Report at 24·9 years. The annual death-rate is placed at 38·4, and the birth-rate at 44·4 per thousand. These figures are admittedly mere approximations. They refer, moreover, to the whole Empire, and there are great local variations. The mean age of the living in Northern India is estimated to be nearly one year greater than in Bengal and Bombay, and it is thus inferred that the Aryan element in the population enjoys a relatively greater longevity than the Mongolian or Dravidian. It must, however, be remembered that the mean age of the living depends not only on the longevity of the people, but also on the extent to which the birth-rate exceeds the death-rate. The influence of famine on the age distribution is well marked; and in Bengal, which suffered little during the decade preceding the Census of 1901, there are 1,327 per 10,000 males under the age of ten, compared with only 1,148 in Bombay, where the stress was exceptionally severe: the corresponding proportion for the latter Province in 1891, when there had been no famine for more than ten years, was 1,437. In the Central Provinces (outside Berār), where there has been a decrease in the total population of 8·3 per cent., the age statistics show that this is due entirely to losses among the very old and the very young, the number of persons between the ages of ten and forty being slightly greater than it was in 1891. The general birth-rate, as estimated in the Census Report, is high compared with that of most European countries; but this is explained by the greater longevity of European races, which reduces the proportion borne by persons at the reproductive

ages to the total population, coupled with the greater frequency of the married state in India, where 78 per cent. of the females between fifteen and forty-five years of age are married, compared with only 47 per cent. in England. If we calculate the birth-rate on the number of married females at the above ages, instead of on the total population, the proportion per thousand in India is 247·5 as against 254·9 in England. The birth-rate is highest among the Animistic tribes and lowest in the case of the Hindus, while the rate for Muhammadans approaches more nearly to the former than to the latter. These variations seem to depend mainly on causes similar to those which have been cited in explanation of the difference between India as a whole and England.

In most European countries the females outnumber the males, but in India there are only 963 of this sex per 1,000 males. The general result is shared by all Provinces and States except the Central Provinces and Madras, where there is a marked excess of females, and Bengal, where the two sexes are on a par, a superfluity of females in Bihār, Orissa, and Chotā Nāgpur being counterbalanced by a marked deficiency in Bengal proper. The dearth of females is extraordinarily great in Coorg, Baluchistān, the Punjab, and Kashmīr, where it exceeds one in nine, and is almost as marked in Ajmer and Rājputāna. Next follow Baroda, the United Provinces, Bombay, and Central India; then Assam, Burma, and Hyderābād. The crude proportions are, however, affected not only by natural causes, but also by migration; and if we allow for this by replacing all emigrants in the Province or State in which they were born, the number of females per thousand males rises in Burma from 962 to 1,027, in Assam from 949 to 973, in Coorg from 801 to 963, and in Mysore from 980 to 994. In the United Provinces, on the other hand, it falls from 937 to 926, in the Punjab from 852 to 849, and in Madras from 1,025 to 1,011. The general result, after discounting the effect of migration, is that females are outnumbered by males throughout the western half of India, especially in the northern portion, while in the eastern half the reverse is everywhere the case, save only in Bengal proper and Assam. The general proportion of females appears to be steadily rising; but in the Punjab there has been no change since 1891, and in Bengal there has been a continuous decline since 1881. The greatest improvement during the last decade has occurred in the Central Provinces, where it has been explained on the ground that females are constitutionally the stronger sex and so less liable to succumb

Sex.

to the effects of insufficient food and the diseases consequent thereon. This hypothesis accords with the variations recorded at different enumerations in other parts of India and with the opinions of competent observers, and it may be accepted as fully established.

It is less easy to find a satisfactory explanation of the causes which, in the greater part of India, have produced a deficiency of females. It does not seem to be due, to any appreciable extent, to their concealment at the Census, nor can any correlation be traced between the proportions of the sexes and climate, season of gestation, food, consanguineous marriages, and the like. In former times the difficulty and expense of obtaining husbands led in some parts to the destruction of female infants. This practice was specially common among the Rājputs of north-western India; but it has now been put down and still lingers in very few places, and there only among certain sections of the population. But even where female infanticide is no longer, or perhaps never was, in vogue, there is no doubt that female children receive far less care than those of the other sex. It follows that, in comparison with males, fewer survive the diseases of infancy than in Europe, where the number of males at birth exceeds that of females to almost the same extent as it does in India, but where their excess mortality is so great as to reduce them to a minority before the close of the first year of life[1]. Nor is it only in infancy that female life is exposed to relatively greater risks than in Europe. There is also the danger of functional derangement due to premature cohabitation and child-bearing, unskilful midwifery, exposure, and hard labour. Apart from these factors of a more or less general character, it is possible that the proportions are influenced by race. Among the Dravidians females are distinctly more numerous than among the castes of Aryan or semi-Aryan descent. In the case of the Mongoloid races the results are less uniform: females preponderate in the Western Himālayan region and in Burma, and also among many of the Assam tribes; but they are in a minority in Northern and Eastern Bengal; among the cognate races in Assam, the Kaibarttas, Chandāls, and various Bodo tribes; and also among the Lepchās and other Himālayan tribes on the northern frontier of Bengal. It may be added that the registered proportion of female to male births varies from time to time: in the Punjab, for example, it was 91 per cent. in 1896, compared with 88 only four years earlier.

[1] Even in India the proportion of females to males at the Census is generally considerably in excess of that disclosed by the birth statistics.

The universality of marriage among all sections of the population of India has already been alluded to. About half the total number of males are unmarried (see Table VIII, p. 494), but of these three-quarters are under fifteen years of age. Among males between thirty and forty years of age only one in 12 is celibate, and among those between forty and sixty only one in 20. The figures for females are even more striking. Only one-third of the total number are unmarried, and of these three-quarters are under the age of ten, and seven-tenths of the remainder under fifteen. Less than one-twelfth of the females returned at the Census as single had completed the fifteenth year of their age, and of these the great majority were either prostitutes or concubines, or were suffering from some serious bodily affliction. It does not, of course, follow that all who are not single have a husband or wife: there is also the great category of the widowed[1], which embraces one-eighteenth of the male and one-sixth of the female population. The number of widowed males under forty years of age is insignificant; but among females aged 20–30 no less than one-eleventh are already widowed, and more than one-fifth of those aged 30–40. At 40–60 one-half are widowed, and at 60 and over more than four-fifths.

Marriage.

In illustration of the great difference between India and England in respect of marriage customs, it may be mentioned that in England from three-fifths to two-thirds of both sexes are single and about a third are married, while only one male in 30 is widowed and one female in 13. The proportions among these classes depend, of course, not only on the number of persons who enter into matrimony, but also on the absolute and relative ages of the parties at marriage, and on the extent to which persons who have lost one helpmate are in the habit of taking a second. Marriage takes place at a much earlier age in India, especially among females, while widows marry again far less frequently, and even widowers less often, than in Europe.

Within the limits of India, again, there are marked variations, both by religion and locality. Muhammadans, Buddhists, and Animists marry later than the Hindus, and their proportion of married persons is consequently smaller, though not so small as it would be were it not that they allow and practise widow marriage to a greater extent than do the Hindus. The higher castes of Hindus almost everywhere forbid their widows to

Variations in marriage customs by religion and locality.

[1] The number of the divorced in India is inconsiderable. Divorce, even when recognized, is of very rare occurrence, and the few persons returned under this denomination were classed as widowed.

remarry; in some parts, e.g. in Bengal proper, all but the very lowest castes follow their example; but elsewhere, as in Bihār, this is not so. The prevalence of infant marriage among Hindus is also far from uniform; and whereas in Southern India the number of child-wives is small, in Berār one-sixth, and in Bihār nearly one-fifth, of the total number of females under ten years of age are married[1]. It must be remembered, however, that cohabitation is, generally speaking, deferred until the girl is mature, the principal exceptions to this rule being confined to Bengal. The marriage of a girl before she attains the age of puberty is inculcated in the Shāstras, but this fact leaves the local variations in the practice still to be accounted for. Where the custom of demanding a high bride-price is in vogue, as among certain castes of Bengal proper, males usually marry late, either because they cannot provide the necessary expenditure earlier, or because they do not care to do so until the time has come when they are able to enter on real married life. Similarly where the bridegroom has to be paid for, as among the Rājputs and Chārans of Rājputāna, the girls usually attain, and frequently pass, the age of puberty before they are given in marriage. Where neither side has to pay much and the marriage ceremony is inexpensive, a custom has in some parts sprung up (chiefly among the lower castes) of giving boys and girls in marriage while both parties are still children; and for this it is difficult to find an explanation, unless perhaps that the Brāhmans consider it to be their interest to promote marriage, and pocket the fees which it brings to them at the earliest opportunity. It may be added that where local or caste rules forbid widows to remarry, parents are often reluctant to give their daughters in wedlock at a very early age and so expose them to the risk of a long life of misery.

Animists, Muhammadans, and Buddhists usually keep their girls single till several years after puberty, but in Baroda and Central India infant marriage appears to be in vogue among the Bhīls and cognate Animistic tribes.

Polygamy. Although in theory polygamy is allowed, in practice a second wife is rarely taken while the first is alive, and in India as a whole there are only 1,011 wives to every 1,000 husbands, so that even if no husbands have more than two wives, all but 11 per thousand must be monogamous. The excess of wives is greatest (31 per thousand) among Animists, and next greatest among Muhammadans (21 per thousand): in the case of

[1] In one District of Bihār the proportion exceeds two-fifths.

Hindus and Buddhists it is only 8 and 7 per thousand respectively, while among Christians, who are of course strict monogamists, and of whom many are foreigners, the excess is on the side of the husbands.

Polyandry.

There are two recognized types of polyandry—the matriarchal, where a woman forms simultaneous alliances with two or more men who are not necessarily related to each other, and succession is therefore traced through the female; and the fraternal, where she becomes the wife of several brothers. The former practice was once prevalent among the Nāyar and other castes on the Malabar coast, but it has now fallen into desuetude, though the women enjoy full liberty (which, however, is seldom exercised) to change their husbands, and succession is still traced through the female, i.e. a Nāyar's next heirs are not his own sons, who belong to their mother's family, but his sister's. The latter form of polyandry is still more or less common along the whole of the Himālayan area from Kashmīr to Assam, and likewise among the Todas of the Nīlgiris. It exists as a recognized institution chiefly among people of Tibetan affinities, but it occurs also, though more or less concealed, among various communities in the plains, such as the Jāts of the Punjab and the Santāls of Bengal. The census returns, however, throw no light on this subject.

Education.

At the Census of 1901 the population was divided into two broad categories—the literate, or those who could both read and write, and the illiterate who could not do so. Even in this limited sense of the word only 53 per thousand were returned as literate, viz. one male in 10, and one female in 144[1], but it seems probable that the true proportions are somewhat higher. According to the census returns the proportion is smaller at the school-going ages than it is in later life, and the inference seems to be that many of those still under instruction were excluded from the category of the literate. In the case of females, moreover, there have probably been some omissions, owing to the prejudice against admitting that women are thus qualified which prevails in some sections of the population. Of the larger British Provinces Burma easily holds the first place, two-fifths of its male, and one-eleventh of its female, population being able to read and write. This Province enjoys an extensive system of indigenous free education, imparted by the *pongyis* or Buddhist monks attached to the monasteries; but the teaching is of a very elementary

[1] For actual figures at various ages see Table IX (p. 495).

kind, and the number of really educated persons is relatively much smaller in Burma than in many other Provinces. According to the census returns, Madras stands next to Burma, with scarcely a third of its proportion of literate persons; then follow Bombay and Bengal; and then, at a considerable distance, Assam, the Punjab, the United Provinces, and the Central Provinces. The Native States taken as a whole have only 79 males and 6 females who are literate per thousand of each sex; but Cochin, Travancore, and Baroda occupy a higher position than any British Province except Burma.

The proportion of literate persons is highest along the sea-coast and gradually diminishes as one proceeds inland. There are more persons able to read and write among those who speak Dravidian and Mongolian languages than among those whose vernaculars belong to the Aryan family. Of the religious communities the Pārsīs stand first, with two-thirds of their total able to read and write. Then come the Jains with 25, and the Buddhists with 22 per cent., while the Christians follow close on the Buddhists. A long gap ensues, and then come the Sikhs and Hindus, who have 6 and 5 per cent. respectively; then the Muhammadans with 3; and last of all the Animists, with less than ½ per cent. The general position of Muhammadans is determined by the figures for Bengal and the Punjab, where the bulk of them are found; elsewhere it is at least as good as that of the Hindus.

Of the total population of India, 68 males and 7 females in 10,000 persons of each sex were returned as literate in English; but if Christians be excluded, the proportions fall to 56 males and 1 female. The Pārsīs stand easily first among the indigenous religious communities, no less than two-fifths of their males and one-tenth of their females being able to read and write English. Then come in order Jains, Hindus, Sikhs, Muhammadans, Buddhists, and Animists, with proportions ranging, in the case of males, from 134 to 2 per 10,000, while for females the maximum is 1 per 10,000. These figures are merely general averages, and in special cases, e.g. among the Baidyas of Bengal or the Prabhus of Bombay, there is quite a remarkable number of English-knowing persons. The knowledge of this language is most widespread in Madras, Bombay, and Bengal. The Native States generally are backward, but this is not the case in Cochin, Travancore, and Mysore.

The corresponding returns for previous enumerations were under three heads—learning, literate, and illiterate—and it is thus impossible to institute an effective comparison with them.

The infirmities regarding which information was collected at the Census were insanity, deaf-mutism, blindness, and leprosy. The total number of persons suffering from one or other of these four afflictions shows a progressive decline from 937,063 in 1881 to 670,817 in 1901. It is probable that in recent years these unfortunate persons, a large majority of whom belong to the lowest grades of society and subsist mainly by begging, have suffered from the ravages of plague and famine to a far greater extent than the general population. It is also probable that the long period of peace and growing material prosperity which, in spite of occasional set-backs, the country has enjoyed under British rule, coupled with the spread of education, the greater attention paid to sanitation, and, above all, the increasing medical relief afforded at the public hospitals and dispensaries, must have combined, directly and indirectly, to reduce the number of the afflicted. At the same time there seems to be no doubt that a large part of the reduction that has taken place is due to greater care in eliminating from the returns maladies which did not properly belong to the four heads mentioned above. The total number of persons returned as of unsound mind in 1901 was 66,205, or less than one in every 4,000. It is believed that cretins, and imbeciles generally, were not, as a rule, thus classed by the enumerators, and that the figures refer principally to the more acute forms of mental disorder. According to the returns, this affliction is most prevalent in Burma, the northern part of Bengal proper, Kashmīr, and Assam; and least so in the United and the Central Provinces. In all 153,168 persons (i.e. 6 males and 4 females per 10,000 of each sex) were returned as deaf-mutes. This infirmity, which is often combined with cretinism and goître, is most common in the sub-Himālayan area and especially along the banks of certain rivers. The blind numbered 354,104, or 12 males and 12 females per 10,000, compared with 9 males and 8 females in England and Wales. Blindness is more common in all tropical countries than in those which enjoy a temperate climate. In India the affliction is far more prevalent in the dry and arid plains of Rājputāna and the Punjab than in the humid tracts in the deltas of the Ganges and Irrawaddy, where there is comparatively little dust and glare, and the houses in which the people live are larger, lighter, and better ventilated. The number of persons returned as lepers was 97,340, i.e. 5 males and 2 females in every 10,000. The disease is remarkably local: it is most prevalent in Northern Arakan (Burma) and in

Infirmities.

a small group of Districts in Western Bengal; then come the Goālpāra District of Assam and the western part of Berār; then a tract on the lower spurs of the Himālayas, lying partly in the Punjab and partly in the United Provinces; and next, Orissa. These tracts appear to have little or nothing in common, and no plausible explanation of their greater liability to leprosy is forthcoming.

Occupations. The Census return of occupations summarized in Table XIII (p. 499) is subject to several limitations. It refers only to the state of things on a particular day; and occupations of a seasonal character, such as earth-work, jute pressing, indigo manufacture, rice milling, &c., are thus obliterated or unduly magnified. The figures, moreover, relate only to the principal occupation, and persons who combine several means of livelihood were entered under the main one only[1]. This, though unavoidable, is a serious defect: division of labour has not yet proceeded very far in India, and the same man often combines several pursuits which in Europe would be quite distinct. The fisherman, for instance, is often a boatman, the money-lender a landowner, the shepherd a blanket-weaver, and the maker of most articles of common use is also the seller of the same. Lastly, the entries were often (1) vague, so that it was impossible to say definitely what form of employment was referred to; or (2) incorrect, either intentionally, as when occupations which are held to be more reputable were returned instead of others of a meaner nature, or accidentally, owing to confusion of thought and the failure to distinguish clearly between a man's traditional occupation, as indicated by his caste, and the actual pursuit by means of which he earns his living.

At the same time there are certain main features which stand out very clearly. Nearly two-thirds of the population in 1901 relied on some form of agriculture as their principal means of subsistence: 52 per cent. were either landlords or tenants, 12 per cent. were field labourers, and about 1 per cent. were growers of special products or engaged in estate management, &c. In addition to these, about 2½ per cent., who mentioned some other form of employment as the chief source of their livelihood, were also partially agriculturists; and another 6 per cent., who were shown as 'general labourers,' were doubtless in the main supported by work in the fields. About 15 per cent. of the population are maintained by the preparation and

[1] There was one exception: persons partially agriculturists were shown as such where agriculture was the secondary, as well as where it was the main, occupation.

supply of material substances; and of these more than a third find a living by the provision of food and drink, and a quarter by working and dealing in textile fabrics and dress. Domestic and sanitary services provide a livelihood for only 4 per cent. of the population; and commerce, the learned and artistic professions, and service under Government for barely half as many each. In cities, as might be expected, the functional distribution is very different from that in the country as a whole: the proportion of persons dependent on agriculture falls from two-thirds to one-twelfth; the number engaged on the preparation and supply of material substances rises from one-seventh to two-fifths; one-eighth derive a livelihood from commerce, and nearly as many from personal and domestic services; one-eleventh from unskilled labour, and one-fourteenth from Government service. The persons who most frequently practise agriculture in conjunction with other pursuits are those engaged in Government service; and the village servants, such as potters, blacksmiths, washermen, and barbers: the latter are in most parts regular members of the village community, whose rights and duties are strictly hereditary, and who hold a small allotment of land, which they usually cultivate themselves, in part payment for their services. The devolution of occupation from father to son, here alluded to, which is so closely bound up with the caste system, is perhaps the most striking feature in the functional distribution of the people of India. The son of a priest is generally a priest; of a potter, a potter; and so forth. This is often the case even with criminal pursuits, such as *thagī* (now happily extinct) and offences against property. There are many wandering gangs of hereditary criminals whose ostensible means of livelihood are basket-making, fortune-telling, juggling or peddling; but who really subsist on the profits of cattle-lifting, and of thefts and dacoities based on information gleaned by their women while plying their professed trade. The supervision of these gangs is one of the recognized duties of the police. In recent years, however, a process of disintegration has set in and the influence of heredity on function is growing weaker. Under the British Government all paths of employment are open to high and low alike; education is no longer the prerogative of the higher castes; improved communications have enabled the people to move about freely in search of a livelihood; and various new occupations have been created, while a few have become less profitable. People are thus beginning to desert the avocations of their ancestors in favour of others which they regard as

more remunerative or more respectable. This is the case even with the Brāhmans, large numbers of whom are found not only in Government service and in the law courts, but also in the ranks of physicians, landholders, traders, cooks, &c. The most marked defection from their hereditary craft is shown by the hand-weavers, who are unable to compete successfully with the machine-made products of Lancashire and Bombay. As regards new avenues of employment opened up under British rule, the census returns show that nearly a million persons are supported by employment on tea gardens, over half a million on railways, 154,000 in the post office and telegraph services, and 106,000 on coffee plantations. According to the same statistics, which are, however, far from complete, more than $1\frac{1}{3}$ million persons are employed in factories, coal-mines, and the like: the cotton mills, chiefly in Bombay, account for 348,000, and the jute mills of Bengal for 131,000. The total thus already exceeds 3,000,000, and there are indications that it will be greatly increased in the near future. The local production of coal, coupled with the extension of railway communication, has removed one of the chief obstacles to progress, and native capital is beginning to flow more freely towards industrial enterprise, though it still lacks confidence in joint-stock undertakings.

It is very difficult, in India, to distinguish between workers and dependents; but, so far as the figures collected at the Census can be relied on, 47 per cent. of the population work for their living and 53 per cent. are dependent on others. Of the males two-thirds were returned as actual workers, and of the females only one-third. The absolute number of female workers is greatest in the case of rent-payers, field and general labourers, and rent-receivers, but in all these cases male workers are also very numerous: flour-grinding, silkworm rearing, rope and net-making, midwifery, and tattooing are avocations which are more or less the monopoly of women.

E. A. GAIT.

Note.—For further information on the subject of this chapter see *Report on the Census of India*, 1901.

TABLE I

General Statement

	India.	Provinces.	States.
Area in square miles	1,766,597	1,087,204	679,393
Number of Towns and Villages	730,753	551,481	179,272
(a) *Towns*	*2,148*	*1,451*	*697*
(b) *Villages*	*728,605*	*550,030*	*178,575*
Number of Occupied Houses	55,841,315	43,444,070	12,397,245
(a) *In Towns*	*5,590,859*	*4,080,936*	*1,509,923*
(b) *In Villages*	*50,250,456*	*39,363,134*	*10,887,322*
Total population	294,361,056	231,899,507	62,461,549
(a) *In Towns*	*29,244,221*	*22,142,257*	*7,101,964*
(b) *In Villages*	*265,116,835*	*209,757,250*	*55,359,585*
Males	149,951,824	117,804,942	32,146,882
(a) *In Towns*	*15,499,786*	*11,840,791*	*3,658,995*
(b) *In Villages*	*134,452,038*	*105,964,151*	*28,487,887*
Females	144,409,232	114,094,565	30,314,667
(a) *In Towns*	*13,744,435*	*10,301,466*	*3,442,969*
(b) *In Villages*	*130,664,797*	*103,793,099*	*26,871,698*

TABLE II

Variation in Population

		India.	Provinces.	States.
Total population in	1872	206,162,360	185,163,353	20,999,007
	1881	253,896,330	199,103,821	54,792,509
	1891	287,314,671	221,239,515	66,075,156
	1901	294,361,056	231,899,507	62,461,549
Males	1872	106,055,545	95,297,694	10,757,851
	1881	129,949,290	101,448,747	28,500,543
	1891	146,769,629	112,573,612	34,196,017
	1901	149,951,824	117,804,942	32,146,882
Females	1872	100,106,815	89,865,659	10,241,156
	1881	123,947,040	97,655,074	26,291,966
	1891	140,545,042	108,665,903	31,879,139
	1901	144,409,232	114,094,565	30,314,667
The above figures are inclusive of new areas as follows:—				
Enumerated for the first time in	1881	33,139,081	235,698	32,903,383
	1891	5,681,470	3,107,060	2,574,410
	1901	2,416,109	1,913,609	502,500

NOTE.—Manipur was included in the population enumerated in 1881 but not in 1891: its population has therefore been deducted from the figures showing the population of new areas added in the latter year.

The new areas are as follows:—

In 1881. Convict settlement in Andamans, Central India Agency, Hyderābād, Punjab States, Rājputāna, and Manipur.

In 1891. North Lushai, Upper Burma (excluding Shan States), Kashmīr, and Sikkim.

In 1901. Native tribes in Andamans; Manipur (schedules destroyed in 1891); Shan States and Chin Hills; Malakand, Dīr, Swāt, Chitrāl, Kurram, and Shirāni country in North-west Frontier Province; Baluchistān, and Baluchistān Agency.

TABLE III. Population distributed by Provinces and States

Province, State, or Agency.	Area. Sq. Miles.	Population in 1891. Total.	Population in 1901. Males.	Population in 1901. Females.	Population in 1901. Total.	Percentage of Increase or Decrease, 1891–1901.
India (Grand Total)	1,766,597	287,314,671	149,951,824	144,409,232	294,361,056	2·4
Provinces (Total)	1,087,204	221,239,515	117,804,942	114,094,565	231,899,507	4·8
1. Ajmer-Merwāra	2,711	542,358	251,026	225,886	476,912	−12·1
2. Andamans and Nicobars	3,143	15,609	18,695	5,954	24,649	+57·9
3. Assam	56,243	5,477,302	3,143,692	2,982,651	6,126,343	+11·8
4. Baluchistān (Districts and Administered Territories)	45,804	. .	178,526	129,720	308,246	. .
5. Bengal	151,185	71,346,961	37,376,782	37,368,084	74,744,866	+4·7
6. Bombay	123,064	18,878,314	9,583,409	8,976,152	18,559,561	−1·6
7. Burma	236,738	7,722,053	5,342,033	5,148,591	10,490,624	+35·8
8. Central Provinces, including Berār *	104,169	13,681,785	6,250,284	6,380,378	12,630,662	−7·7
9. Coorg	1,582	173,055	100,258	80,349	180,607	+4·4
10. Madras	141,726	35,630,440	18,841,284	19,368,152	38,209,436	+7·2
11. North-West Frontier Province	16,466	1,857,504	1,159,306	966,174	2,125,480	+14·4
12. Punjab	97,209	19,009,343	10,942,705	9,387,634	20,330,339	+6·9
13. United Provinces of Agra and Oudh	107,164	46,904,791	24,616,942	23,074,840	47,691,782	+1·7
States and Agencies (Total)	679,393	66,075,156	32,146,882	30,314,667	62,461,549	−5·4
14. Baluchistān (Agency tracts)	86,511	. .	266,994	235,506	502,500	. .
15. Baroda	8,099	2,415,396	1,008,634	944,058	1,952,692	−19·1
16. Bengal States	38,652	3,326,837	1,901,404	1,847,140	3,748,544	+12·7
17. Bombay States	65,761	8,082,107	3,513,003	3,395,645	6,908,648	−14·5
18. Central India Agency	78,772	10,318,812	4,428,790	4,199,991	8,628,781	−16·4
19. Central Provinces States	29,435	2,160,511	988,830	1,007,553	1,996,383	−7·6
20. Hyderābād	82,698	11,537,040	5,673,629	5,467,513	11,141,142	−3·4
21. Kashmīr	80,900	2,543,952	1,542,057	1,363,521	2,905,578	+14·2
22. Madras States	9,969	3,700,622	2,098,048	2,090,038	4,188,086	+13·1
23. Mysore	29,444	4,943,604	2,797,024	2,742,375	5,539,399	+12·0
24. Punjab States	36,532	4,263,280	2,409,809	2,014,589	4,424,398	+3·8
25. Rājputāna Agency	127,541	11,990,504	5,104,246	4,619,055	9,723,301	−18·1
26. United Provinces States	5,079	792,491	414,414	387,683	802,097	+1·2

* See footnote on page 453.

TABLE IIIA

BENGAL, ASSAM, AND THE CENTRAL PROVINCES AS RECONSTITUTED IN 1905

	Area. Sq. Miles.	Total Population.	Religions.		
			Hindus.	Muhammadans.	Others.
PROVINCES.					
Bengal . .	110,054	50,723,318	39,267,301	9,027,069	2,428,948
Eastern Bengal and Assam .	101,147	30,788,134	11,519,574	17,823,129	1,445,431
Central Provinces (including Berar)	100,396	11,990,419	9,943,186	503,792	1,543,441
STATES.					
Bengal . .	31,526	3,373,488	2,896,802	12,886	463,800
Eastern Bengal and Assam .	5,393	740,299	517,138	213,559	9,602
Central Provinces	31,168	1,631,140	1,109,566	15,640	505,934

N.B.—The figures are based on the Census of 1901.

TABLE IV

TOWNS AND VILLAGES CLASSIFIED BY POPULATION

Towns and Villages containing a Population of—	India.		British Territory.	
	Number.	Population.	Number.	Population.
(Total)	730,753	294,361,056	551,481	231,899,507
Under 500 . . .	579,277	104,569,655	430,271	79,787,910
500—1,000 . .	96,362	66,565,959	76,693	53,102,876
1,000—2,000 . .	39,938	54,259,039	32,252	43,849,077
2,000—5,000 . .	12,925	36,487,003	10,526	29,684,595
5,000—10,000 .	1,509	10,000,418	1,162	7,656,006
10,000—20,000 .	499	6,821,133	387	5,315,393
20,000—50,000 .	165	5,017,785	131	4,043,603
50,000—100,000 .	51	3,512,362	36	2,508,474
Over 100,000 . .	27	6,296,956	23	5,465,077
Enumerated in railway premises, boats, encampments, or relief works	. .	798,266	. .	454,016
Not returned * . .	. .	32,480	. .	32,480

* Includes 1,882 Andamanese and 6,310 Nicobarese enumerated for the first time in 1901, without any details, besides 201 foreign traders in the Nicobars; also 24,087 persons enumerated in the Baloch trans-frontier country, without further details.

TABLE V

POPULATION OF CHIEF TOWNS

(Those in Italics are in Native States)

Town.	Population in 1901.	Variation since 1891.
1. Calcutta and Suburbs	1,106,738	+ 224,622
Calcutta and Fort	847,796	+ 165,491
Cossipore—Chitpur, Mānikṭala, Garden Reach	101,348	+ 18,143
Howrah	157,594	+ 40,988
2. Bombay *	776,006	− 45,758
3. Madras *	509,346	+ 56,828
4. *Hyderābād* *	448,466	+ 33,427
5. Lucknow *	264,049	− 8,979
6. Rangoon *	234,881	+ 54,557
7. Benares *	209,331	− 10,136
8. Delhi *	208,575	+ 15,996
9. Lahore *	202,964	+ 26,110
10. Cawnpore *	197,170	+ 8,458
11. Agra *	188,022	+ 19,360
12. Ahmadābād *	185,889	+ 37,477
13. Mandalay *	183,816	− 4,999
14. Allahābād *	172,032	− 3,214
15. Amritsar *	162,429	+ 25,663
16. *Jaipur*	160,167	+ 1,380
17. Bangalore †	159,046	− 21,320
18. Poona *	153,320	− 8,070
19. Patna	134,785	− 30,407
20. Bareilly *	131,208	+ 10,169
21. Nāgpur	127,734	+ 10,720
22. *Srīnagar*	122,618	+ 3,658
23. Surat	119,306	+ 10,077
24. Meerut *	118,129	− 1,261
25. Karāchi *	116,663	+ 11,464
26. Madura	105,984	+ 18,556
27. Trichinopoly *	104,721	+ 14,112
28. *Baroda* *	103,790	− 12,630
29. Peshāwar *	95,147	+ 10,956
30. Dacca	90,542	+ 8,221
31. Jubbulpore *	90,316	+ 5,835
32. *Lashkar* (Gwalior)	89,154	− 14,929
33. Rāwalpindi *	87,688	+ 13,893
34. Multān *	87,394	+ 12,832
35. *Indore*	86,686	+ 3,702
36. Mirzāpur	79,862	− 4,268
37. *Rāmpur* *	78,758	+ 2,025
38. Ambāla *	78,638	− 656
39. *Bhopāl*	77,023	+ 6,685
40. Calicut *	76,981	+ 10,903
41. Shāhjahānpur *	76,458	− 2,064
42. Bhāgalpur	75,760	+ 6,654
43. Sholāpur	75,288	+ 13,373
44. Morādābād	75,128	+ 2,207
45. Fyzābād *	75,085	− 3,836
46. Ajmer	73,839	+ 4,996
47. Gayā	71,288	− 9,095
48. Salem	70,621	+ 2,911
49. Alīgarh (Koil)	70,434	+ 8,949
50. Hyderābād (Sind) *	69,378	+ 11,330
51. *Mysore*	68,111	− 5,937
52. Jullundur *	67,735	+ 1,533
53. Farrukhābād *	67,338	− 10,694
54. *Imphal* *	67,093	. .
55. Sahāranpur	66,254	+ 3,060
56. Darbhangā	66,244	− 7,317
57. Gorakhpur *	64,148	+ 528
58. *Jodhpur*	60,437	− 1,322
59. Hubli	60,214	+ 7,619
60. Muttra *	60,042	− 1,153
61. Kumbakonam	59,673	+ 5,366
62. Moulmein	58,446	+ 2,661
63. Bellary *	58,247	− 1,220
64. Siālkot *	57,956	+ 2,869
65. *Trivandrum*	57,882	+ 29,995
66. Tanjore	57,870	+ 3,480
67. Negapatam	57,190	− 2,031
68. *Alwar*	56,771	+ 5,344
69. *Bhaunagar* *	56,442	− 1,211
70. Jhānsi *	55,724	+ 1,945
71. *Kolhāpur* *	54,373	+ 8,558
72. *Navānagar*	53,844	+ 5,314
73. *Patiāla*	53,545	− 2,311
74. Coimbatore	53,080	+ 6,697
75. *Bīkaner*	53,075	+ 2,562
76. Cuddalore	52,216	+ 4,861
77. Cuttack *	51,364	+ 4,178

* Includes cantonment population. † Includes civil and military station.

TABLE VI. RELIGION

Religion.	India.	Provinces.	States.
INDIA (Total)	294,361,056	231,899,507	62,461,549
Hindu	207,147,026	158,601,288	48,545,738
Muhammadan	62,458,077	53,804,517	8,653,560
Buddhist	9,476,759	9,411,449	65,310
Animistic	8,584,148	5,899,194	2,684,954
Christian	2,923,241	1,904,264	1,018,977
Sikh	2,195,339	1,574,579	620,760
Jain	1,334,148	478,700	855,448
Zoroastrian (Pārsī)	94,190	79,942	14,248
Jew	18,228	15,848	2,380
Minor Religions and Religions not returned	129,900	129,726	174

TABLE VII. AGE

AGE.	INDIA.		BRITISH TERRITORY ONLY.	
	Males.	Females.	Males.	Females.
INDIA (Total)	149,951,824	144,409,232	117,804,942	114,094,565
Under 5	18,735,774	19,268,997	15,136,206	15,597,881
5—10	20,831,085	19,895,462	16,595,846	15,912,606
10—15	18,880,658	15,566,718	14,716,972	12,163,925
15—20	12,942,322	12,017,833	9,998,477	9,413,297
20—25	11,757,643	12,834,857	9,149,227	10,063,670
25—30	13,133,437	12,875,024	10,286,530	10,147,272
30—35	12,672,440	12,249,131	9,864,614	9,591,516
35—40	9,093,537	8,023,420	7,131,594	6,291,373
40—45	9,686,923	9,383,634	7,505,233	7,303,908
45—50	5,532,217	4,879,297	4,362,197	3,844,710
50—55	6,530,923	6,510,257	5,087,959	5,103,205
55—60	2,644,466	2,429,967	2,071,445	1,915,670
60 and over	6,956,311	7,944,950	5,614,850	6,504,709
Age not returned	23,117	26,900	19,815	23,544
Not enumerated by age	530,971	452,785	263,977	217,279

TABLE VIII. Civil Condition

Age and Condition.	India.		British Territory only.	
	Males.	Females.	Males.	Females.
INDIA (Grand Total)	149,951,824	144,409,232	117,804,942	114,094,565
All ages				
Unmarried .	73,506,661	49,516,381	57,984,516	39,222,427
Married . .	67,804,108	68,548,130	53,558,338	54,171,410
Widowed . .	8,110,084	25,891,936	5,998,111	20,483,449
Total	149,420,853	143,956,447	117,540,965	113,877,286
Under 5				
Unmarried .	18,608,288	19,006,007	15,039,894	15,390,579
Married . .	121,500	243,503	92,521	192,983
Widowed . .	5,986	19,487	3,791	14,319
Total	18,735,774	19,268,997	15,136,206	15,597,881
5—10				
Unmarried .	20,035,071	17,769,922	15,948,531	14,182,597
Married . .	759,051	2,029,742	621,844	1,656,125
Widowed . .	36,963	95,798	25,471	73,884
Total	20,831,085	19,895,462	16,595,846	15,912,606
10—15				
Unmarried .	16,228,657	8,706,088	12,629,546	6,689,728
Married . .	2,539,279	6,584,768	2,016,205	5,270,983
Widowed . .	112,722	275,862	71,221	203,214
Total	18,880,658	15,566,718	14,716,972	12,163,925
15—20				
Unmarried .	8,409,470	2,152,248	6,507,623	1,638,703
Married . .	4,326,388	9,342,718	3,362,897	7,386,018
Widowed . .	206,464	522,867	127,957	388,576
Total	12,942,322	12,017,833	9,998,477	9,413,297
20—40				
Unmarried .	8,740,894	1,474,367	6,749,284	1,007,814
Married . .	35,501,681	37,800,880	27,977,024	29,895,215
Widowed . .	2,414,482	6,707,185	1,705,657	5,190,802
Total	46,657,057	45,982,432	36,431,965	36,093,831
40—60				
Unmarried .	1,200,767	305,100	889,700	229,107
Married . .	19,894,708	11,229,436	15,692,203	8,747,262
Widowed . .	3,299,054	11,668,619	2,444,931	9,191,124
Total	24,394,529	23,203,155	19,026,834	18,167,493
60 and over				
Unmarried .	273,660	93,386	210,609	75,050
Married . .	4,650,915	1,304,725	3,787,758	1,013,245
Widowed . .	2,031,736	6,596,839	1,616,483	5,416,414
Total	6,956,311	7,994,950	5,614,850	6,504,709
Age not returned				
Unmarried .	9,854	9,263	9,329	8,849
Married . .	10,586	12,358	7,886	9,579
Widowed . .	2,677	5,279	2,600	5,116
Total	23,117	26,900	19,815	23,544
Not enumerated by civil condition .	530,971	452,785	263,977	217,279

TABLE IX. Education

	India.			British Territory only.	
	Total.	Males.	Females.	Males.	Females.
All ages (Total)	293,414,906	149,442,106	143,972,800	117,562,218	113,893,639
Illiterate	277,728,485	134,752,026	142,976,459	105,362,159	13,066,390
Literate	15,686,421	14,690,080	996,341	12,200,059	827,249
Literate in English	1,125,231	1,021,319	103,912	903,922	91,268
Under 10	78,730,991	39,566,675	39,164,316	31,731,868	31,510,344
Illiterate	78,117,103	39,036,282	39,080,821	31,290,708	31,440,499
Literate	613,888	530,393	83,495	441,160	69,845
Literate in English	37,763	27,806	9,957	25,205	8,889
10—15	34,447,235	18,880,576	15,566,659	14,716,890	12,163,866
Illiterate	32,689,965	17,281,530	15,408,435	13,386,023	12,033,080
Literate	1,757,270	1,599,046	158,224	1,330,867	130,786
Literate in English	131,735	117,189	14,546	105,340	12,748
15—20	24,960,036	12,942,258	12,017,778	9,998,413	9,413,242
Illiterate	23,082,470	11,228,351	11,854,119	8,591,924	9,278,154
Literate	1,877,566	1,713,907	163,659	1,406,489	135,088
Literate in English	184,680	168,897	15,783	148,240	13,758
20 and over	155,224,108	78,023,668	77,200,440	61,089,277	60,785,742
Illiterate	143,787,132	67,177,543	76,609,589	52,068,291	60,294,317
Literate	11,436,976	10,846,125	590,851	9,020,986	491,425
Literate in English	770,911	707,326	63,585	625,038	55,832
Age unspecified	52,536	28,929	23,607	25,770	20,445
Illiterate	51,815	28,320	23,495	25,213	20,340
Literate	721	609	112	557	105
Literate in English	142	101	41	99	41
Not enumerated by education	946,150	509,718	436,432	242,724	200,926

Note.—Persons knowing English are included in the figures for 'Literate.'

TABLE X. LANGUAGE

FAMILY AND SUB-FAMILY.	Population.
INDIA (Total)	294,361,056
VERNACULARS OF INDIA	292,966,163
Family:	
A. Malayo-Polynesian	7,831
B. Indo-Chinese	11,712,299
1. *Mōn-Khmēr*	*427,760*
2. *Tibeto-Burman*	*9,560,454*
3. *Siamese-Chinese*	*1,724,085*
C. Dravido-Muṇḍā	59,693,799
1. *Muṇḍā*	*3,179,275*
2. *Dravidian*	*56,514,524*
D. Indo-European	221,157,673
(*Aryan Sub-Family*)	*221,157,673*
E. Semitic	42,881
F. Hamitic	5,530
G. Unclassed	346,150
VERNACULARS OF OTHER ASIATIC COUNTRIES, AFRICA, AND AUSTRALIA.	76,673
H. Indo-European	20,968
I. Semitic	1,320
J. Hamitic	314
K. Mongolian	51,287
L. Malayo-Polynesian	2,461
M. Bantu	323
VERNACULARS OF EUROPE	269,997
N. Indo-European	269,975
O. Mongolian	22
LANGUAGE NOT RETURNED OR NOT IDENTIFIED, ETC.	1,048,223

TABLE XI. Birth-place

Province, State, or Agency.	Actual Population at Census.	Immigrants (persons born elsewhere but enumerated in Province or State).	Emigrants (persons born in Province or State but enumerated in other parts of India).
INDIA (Total)	294,361,056	8,180,893	7,026,524
Ajmer-Merwāra	476,912	93,876	25,293
Andamans and Nicobars	24,649	14,219	349
Assam	6,126,343	775,844	51,481
Baluchistān	308,246	300,771	70,986
Bengal	78,493,410	915,158	870,551
Bombay	25,468,209	858,799	626,799
Burma	10,490,624	602,500	9,460
Central Provinces, including Berār	14,627,045	898,769	570,125
Coorg	180,607	55,098	3,192
Madras	38,633,340	269,688	713,069
Punjab and Frontier Province	26,880,217	798,437	435,351
United Provinces	48,493,879	695,956	1,510,295
Baroda	1,952,692	172,931	202,302
Central India Agency	8,628,781	672,263	462,310
Cochin	812,025	50,054	14,622
Hyderābād	11,141,142	325,197	317,790
Kashmīr	2,905,578	85,597	86,157
Mysore	5,539,399	306,379	131,682
Rājputāna States	9,723,301	234,446	900,224
Travancore	2,952,157	54,911	24,486

NOTE.—India, column 2, includes 502,500 persons enumerated in Baluchistān Agency Tracts where birth-place statistics were not recorded.

Column 4 includes only emigrants from the Province or State of birth to other parts of India. An attempt has been made in paragraph 166 of the *Census Report* of 1901 to gauge the volume of emigration outside India.

TABLE XII. Statistics of Main Castes or Tribes

Caste.	Strength.	Where chiefly found.
Ahīr	9,806,475	Northern India.
Arain	1,026,505	Punjab, United Provinces.
Bābhan	1,353,291	Bengal, United Provinces.
Bāgdi	1,042,550	Assam, Bengal.
Balijā	1,036,502	Central Provinces, Madras.
Baloch	1,122,895	Baluchistān, Bombay, Punjab.
Baniā	2,898,126	Most Provinces.
Barhai	1,133,126	Bengal, United Provinces, Central India.
Bhīl	1,198,843	Bombay, Central India, Rājputāna.
Brāhman	14,893,258	Most Provinces.
Burmese	6,511,703	Burma.
Chamār	11,137,362	Northern India.
Chuhrā	1,329,418	North-western India.
Dhangar	1,327,050	Western India.
Dhobi	2,016,914	Most Provinces.
Dosādh	1,258,185	Assam, Bengal, United Provinces.
Fakīr	1,212,648	Most Provinces.
Gadariā	1,272,419	Bengal, Central Provinces, United Provinces, Central India.
Golā	1,387,472	Bengal, Madras, Hyderābād, Mysore.
Gond	2,286,913	Central Provinces.
Gūjar	2,103,023	Northern India.
Jāt	7,086,098	Northern India.
Jolāhā	2,907,687	Bengal, Punjab, United Provinces, Hyderābād.
Kāchhī	1,260,191	Most Provinces.
Kahār	1,970,825	Most Provinces.
Kaibartta	2,694,329	Assam, Bengal.
Kammālan	1,263,861	Bombay, Madras, Mysore.
Kāpu	3,070,206	Southern India.
Kāyasth	2,149,331	North-eastern India.
Kewat	1,110,767	Assam, Bengal, Central Provinces, United Provinces.
Khattrī	1,030,078	Northern India.
Koiri	1,784,041	Assam, Bengal, United Provinces.
Kolī	2,574,213	Western India.
Kori	1,204,678	Central Provinces, United Provinces, Central India.
Kumhār	3,376,318	Most Provinces.
Kunbī	3,704,576	Western India.
Kurmī	3,873,560	Northern India.
Lingāyat	2,612,346	Bombay, Madras, Hyderābād, Mysore.
Lodhā	1,663,354	Central Provinces, United Provinces, Central India, Rājputāna.
Lohār	2,342,257	Most Provinces.
Mādiga	1,281,252	Madras, Hyderābād, Mysore.
Mahār	2,928,666	Western India.
Māl	1,863,908	Bengal, Central Provinces, Madras, Hyderābād.
Māli	1,915,792	Most Provinces.
Marāthā	5,009,024	Western India.
Muchi	1,007,812	Most Provinces.
Namasūdra	2,031,725	Assam, Bengal.
Nāpit (Hajjām)	2,958,722	Most Provinces.
Nāyar	1,046,748	Southern India.
Palli	2,572,269	Southern India.
Paraiyan	2,258,611	Southern India.
Pāsī	1,408,392	Northern India.
Pathān	3,404,701	Northern India.
Rājbansi	2,408,654	Assam, Bengal.
Rājput	9,712,156	Northern India.
Saiyid	1,339,734	Most Provinces.
Santāl	1,907,871	Assam, Bengal.
Shaikh	28,708,706	Most Provinces.
Teli and Tili	4,025,660	Most Provinces.
Vakkaliga	1,392,375	Southern India.
Vellāla	2,464,908	Southern India.

TABLE XIII

Occupation or Means of Livelihood

Order of Occupation or Means of Livelihood.	Number of Persons supported by each Order.		
	India.	Provinces.	States.
INDIA (Total)	294,361,056	231,899,507	62,461,549
I. Administration	3,814,495	2,924,459	890,036
II. Defence	396,055	332,252	63,803
III. Service of Native and Foreign States	1,397,635	38,453	1,359,182
IV. Provision and Care of Animals	3,976,631	2,802,544	1,174,087
V. Agriculture	191,691,731	155,677,965	36,013,766
VI. Personal, Household, and Sanitary Services	10,717,500	8,217,556	2,499,944
VII. Food, Drink, and Stimulants	16,758,726	13,649,266	3,109,460
VIII. Light, Firing, and Forage	1,461,286	1,093,799	367,487
IX. Buildings	1,579,760	1,166,712	413,048
X. Vehicles and Vessels	132,160	118,901	13,259
XI. Supplementary Requirements	1,231,671	982,578	249,093
XII. Textile Fabrics and Dress	11,214,158	8,653,820	2,560,338
XIII. Metals and Precious Stones	3,710,804	2,866,034	844,770
XIV. Glass, Earthen and Stoneware	2,143,167	1,603,992	539,175
XV. Wood, Cane, and Leaves, &c.	3,790,492	2,938,066	852,426
XVI. Drugs, Gums, Dyes, &c.	455,763	341,628	114,135
XVII. Leather, &c.	3,241,935	2,170,835	1,071,100
XVIII. Commerce	4,197,771	2,716,185	1,481,586
XIX. Transport and Storage	3,528,269	3,075,849	452,420
XX. Learned and Artistic Professions	4,928,092	3,871,397	1,056,695
XXI. Sport	128,043	91,211	36,832
XXII. Earthwork and General Labour	17,953,261	12,528,841	3,424,420
XXIII. Indefinite and Disreputable Occupations	737,033	606,358	130,675
XXIV. Independent	5,001,608	3,257,796	1,743,812
Not Returned by Occupation	173,010	173,010	. .

CHAPTER X

PUBLIC HEALTH AND VITAL STATISTICS

THE general state of the public health in every country depends on the measure of adjustment of the relations of the individual and the race to the environment: the more complete and continuous the adjustment, the greater the longevity. The tendency of European civilization is to give man more and more complete control of his surroundings, whereas in India these are actually and relatively stronger, more capricious and unreliable, than in the West, while the individual is less resistant and adaptable. These influences have moulded the moral and physical character of the people and their civilization; and a brief reference to some of the salient features of the situation will tend to elucidate the vital statistics, as well as to explain some of the peculiar difficulties of the problems they disclose.

Conditions in India as affecting the individual.

As regards the individual, the main general results of the marriage customs are those to be expected from the absence of free selection and from endogamous restriction: viz. increase in the power of transmitting characteristics ('prepotency'), a deterioration of physique [1], lessened resistance to disease, and, possibly, some relative impairment of fertility.

Early marriage.

The almost universal custom of marriage at puberty implies that practically all the immature adolescents of every generation have an equal opportunity of propagating their kind; and there is none of the salutary elimination effected in the West by the celibacy of large classes. The general average product must be lower; and apart from the greater tendency to disease, inherited and acquired, the duration of life is affected in another way. For there is probably a direct relation between early marriage and

[1] The result of 29,000 observations on healthy prisoners in Bengal showed that 60 per cent. were between 5′ 2″ and 5′ 4″ in height; 13 per cent. were below 5′ 2″, and only 0·7 per cent. above 5′ 8″. The average weight of the healthy Bengali peasant was shown to be 109 lb. (7 stone 11 lb.). In Bombay the physical standard is even lower. (Buchanan, *Indian Medical Gazette*, October, 1897.)

the duration of the reproductive functions, and the premature strain on the latter tends to their earlier cessation. The climacteric is advanced, with all the corresponding results of earlier degeneration, and we thus obtain a more rapid vital cycle involving premature senility. As regards the individual, as will be seen later on, an enormous sacrifice is also incurred in the loss of maternal and infant life. On the other hand, the rapid succession of the generations, probably five or more in a century, is favourable to the process of adjustment to an environment that is subject to constant changes: we may see the results in the rapid recuperation of the people after famine and epidemics, and possibly in the relative immunity they possess to some of the chief causes of mortality.

Defective nutrition.

With respect to nutrition, it cannot be doubted that the quality and nature of the food of the majority leaves much to be desired, and on this the measure of vital resistance largely depends, while the quantity available appears to influence the birth-rate in a marked degree. These combined effects are strongly emphasized in times of scarcity and famine, with consequent radical modification in the number, the vitality, and the age constitution of the population. Under ordinary conditions, the essential proteid (nitrogenous) element available is largely diminished by waste in all vegetable food, and primitive methods of cooking and digestive debility add to the loss. These disabilities are greatly enhanced in sickness, when bulky, dry, and ill-cooked food cannot be taken, and this is a factor in the heavy mortality and the economic loss from prostration. Finally, poverty, of which sickness and mortality are perhaps the chief causes, has a direct effect on the resources in food, clothing, and housing, and on the standard of comfort, and so of 'resistance,' while it affects detrimentally the power to achieve measures of amelioration.

The social environment. Influence of religion and custom.

Coming now to the general environment, its special characteristics may be briefly indicated under three heads: religious and moral, social, and physical. The whole tone of religious thought, with its philosophy of fatalism, is against the individualistic self-assertion necessary to success in the struggle for existence; it is opposed to co-operation for civic ideals; and it promotes indifference to life. Evidence of this is seen in the now suppressed practices of the sacrifice of widows (*sati*) and female infanticide, and in the treatment of women in child-bed. Disastrous effects on a larger scale frequently follow on the congregation of vast numbers at places of pilgrimage, where the rites involve overcrowding, exposure, and the consumption

of unwholesome, if sacred, food and water. The duties of daily life, limited in their application to the individual and the family, are ordered and performed as religious rites which the British Government is pledged to respect as long as they do not outrage the moral law; and herein lies one difficulty in securing the observance of the sanitary ordinances which have occupied so large a place in the Statute Book of recent years. The caste constitution of society, if justified in the circumstances of its origin and in many of its results, imposes a rigid bar to free competition and to the development of civilization. Again, many of the conditions of social life are largely the result of the anarchy and insecurity of life and property that prevailed anterior to British rule. This, with the climate and the water-supply, has determined the insanitary structure of the dwellings and their arrangement in aggregates, while the seclusion of women of the better classes has also had evil effects on the race of the natural leaders of the people. There has been little, if any, adjustment to the new conditions which are the outcome of the *pax Britannica*, while the most important of these conditions, operating on the cumulative effects of religion and custom, has resulted in an enormous increase of population. This has led to extraordinary density over great areas, and to overcrowding, to which the development of industrial enterprise has greatly contributed in many large centres, while it must be remembered that an overwhelming proportion of the sickness and mortality is caused by specific communicable diseases.

The physical environment. Influence of rainfall.

Of the predominant features of the physical environment much might be said, but the following remarks must be confined to brief suggestions of the influence of rainfall and range of temperature. Nine-tenths of the vast population live from the land; and the two indispensable conditions of existence, the supply of food and water, depend almost entirely, in the greater part of India, upon the character of the summer monsoon, i.e. upon the rainfall that occurs during some three or four months, which is then stored in, and on, the soil for consumption during the rest of the year. Speaking generally, the country is subject annually to a short period of deluge and a longer one of dryness, but there are the greatest contrasts in the relative intensity of the phenomena in different areas under normal conditions. These, moreover, give place, from time to time, to periods of excess or failure of the rains, with consequent accentuation of the phenomena in proportion to their duration and the area affected. Now, the sources of water-supply are of

three kinds, surface 'tanks' (ponds), shallow wells, and rivers[1], while everywhere, save in a few of the largest towns, all sewage and liquid and solid waste are committed to the soil for disposal, either by deposit on the surface or by burial, and this generally in close proximity to the inhabited site. The effect of heavy and continuous rain, which is far less penetrating in proportion to its quantity than outside the tropics, is to wash the accumulated soil impurities into the water-sources and to leave stagnant collections of water where drainage is defective. The ground-water, replenished by percolation often too rapid for effective filtration, rises quickly in the wells, until in a few weeks, over large areas, it is within a few feet of the surface which it frequently reaches by the end of the monsoon. In this way the majority of the wells of the inhabited sites are rendered saline and non-potable by infiltration of sewage salts. Meanwhile, all the conditions of life have been transformed: water is abundant, but certainly at first impure; coarse green vegetables largely replace the simple grain diet; there are frequent sudden alterations in temperature, against which the clothing resources are inadequate, and the people are driven to the shelter of their dwellings; the cultivation of rice, the staple food-crop of large areas, necessitates interference with the natural drainage; and lastly, there is a great development of insect and micro-organic life. Here we have all the conditions that lead to bowel complaints and fevers; and the mortality curve, which is generally lowest in June, rises, with the monsoon period, to its highest point in the two succeeding months. Thereafter, through the next six months, the course of events is reversed: the water-supplies and surface collections are gradually depleted; and as the hot season advances many are completely exhausted, most of those that persist being reduced to the condition of muddy puddles in the case of wells and tanks, and to a stagnant chain of pools in the case of all but the largest rivers. If the monsoon should fail, or cease early, the conditions are aggravated: the supply of the prime necessity of existence is cut off at innumerable sources, causing an overwhelming call on those that remain, which are subject to greatly enhanced risks of pollution. It is too frequently the custom to use the same supply, indiscriminately, for the various purposes of drinking, bathing, washing clothes, and watering cattle; and it will be understood that in these circumstances an

[1] Water-supply systems, conserved on modern principles, are now (1905) at the disposal of ninety communities, having an aggregate population of 6¼ millions.

outbreak of cholera is frequently added to failure of the food supply. It will be seen later how, by its influence on the mortality and the food-supply, the rainfall also largely affects the birth-rate.

Influence of temperature.

As regards the range of temperature, which varies greatly in different areas at different seasons, but which is generally far greater than in Europe, it is easy to trace its influence on the important vital condition of the supply of pure air in dwellings. It largely determines the materials and structure of these; hence the striking contrast between the reed and thatch hut of the typical Bengal hamlet and the impervious mud and brick structures of the dry inland tracts where the range is highest and where protection from extremes of heat and cold is necessitated. Here, also, dwellings were aggregated under the necessity for defence, and consequently present all the features of camps; there were no arrangements for site-ventilation, or conservancy; and even now the cattle are driven at night into close courtyards, and often into dwellings, which are devoid of appliances for the admission of light and air. The joint-family system involves overcrowding, especially in sleeping rooms, which is most marked in towns; and where the range of temperature is greatest, the effects of the scanty resources in clothing are also most manifest. There is abundant evidence to show that these conditions, varying in degree over large areas, determine the incidence of diseases of the 'zymotic' class, and especially of typhus and the contagious fevers; also of pneumonia, phthisis, and other fatal lung disorders, which are favoured by aggregation in foul air, and which are the causes of a very large proportion of the sickness and mortality.

Preponderating influence of the environment.

To sum up, we have a vast and heterogeneous population, in a primitive and rigid stage of civilization which involves certain physical and moral disabilities, dependent in general on the land not only for daily bread, but for all material resources. The marked feature of the general situation is man's comparative subordination to the environment, against which the struggle is maintained, with varying issue, rather than with his fellow men. The character of the rainfall determines the quantity and quality of the food and water-supplies, and through these, in a large measure, the health of the community, as evidenced by the high and fluctuating birth and death-rates and by the frequent reversal of their normal relations; and this occurs not only in specially unfavourable years, but in certain months of the year under more ordinary circumstances.

In approaching the discussion of the vital statistics of the general population, it is necessary to explain that we are still far from a complete and accurate record of the births and deaths, and of the causes of death; that there is no record of marriages, and but a very inadequate one of sickness. Registration was first instituted in British India generally about thirty years ago, much later in certain areas, and to-day (1905) some of the less accessible hill tracts and most of the Native States are still outside its scope. The difficulties encountered have been great, and many remain. The people, doubtful of the object, shrink from publicity in domestic affairs. The agents are, for the most part, illiterate village watchmen, or town police, who are required to report to the police station at regular but varying intervals the simple fact of birth or death and the supposed cause in the latter event. As to the record of actual occurrences, the error of defect varies considerably in different areas: in some it is almost negligible, in others it may amount to nearly one-third of the total, but there is a general progressive improvement everywhere. The statement of the cause of death leaves much to be desired: the vast majority die without qualified medical attendance, and we have to rely on the crude impressions of the people, who attribute most fatal illnesses marked by a rise of temperature to 'fever,' and who, during epidemics, frequently conceal either the fact or the true cause, in order to escape sanitary measures. At such times, and also during famine, special sources of fallacy arise from the migration of large numbers, so that, even if the facts are obtained by special effort, the local ratios are vitiated. Everywhere efforts are made to check the records by local inquiries, and, in many towns, by supervision of the appointed places for burial or burning.

Vital statistics. Their defective character.

A general Census was first taken between 1867 and 1872, and was repeated in 1881, 1891, and 1901. The value of these enumerations has been inestimable, though the return of ages is by no means accurate and there has possibly been some concealment of females. The figures have enabled us to obtain an approximate estimate of the true birth and death-rates, and of the mortality by age and sex, and thus have afforded data for the construction of a Life Table. The great fluctuations in the birth and death-rates, and the frequent reversal of their normal relations, are marked in the irregular progress of the population, and for this reason the census figures soon become inaccurate for ratio calculations in inter-censal periods. With these limitations, it will be seen that the material for a closely reasoned analysis is

often lacking. But the recorded facts are of great value in the study of the conditions of each area; of far less use, though still suggestive, for inter-Provincial comparisons. Any attempt to trace the effect of sanitary measures on the health of the people is at present beset by obvious fallacies, for as registration improves the rates tend to rise in any case; but there is abundant evidence forthcoming on this question in the vital statistics of the troops and prisoners which are discussed later on in this chapter.

Birth-rate in India.

The following statement gives a general view of the birth-rates recorded in different Provinces during the two decades ending with 1890 and 1900, with other particulars for comparison:—

Birth-rates per 1,000 *in the Chief Provinces of British India*, 1881–1900.

PROVINCE.	Mean annual rate (recorded) for 1881-90. (Non-Famine.)	Mean annual rate (recorded) for 1891-1900. (Famine.)	Highest and lowest annual rates (recorded).	Ratio of births (mean of 1891-1900) per 1,000 married women (15-40) according to Census of 1891.	Probable true normal rate per 1,000 of population *.
Bengal	(not available)	35.9	43.0 28.1	219.6	51.8
Assam	28.5	31.8	35.4 23.9	190.3	. .
United Provinces	39.5	37.7 †	48.1 31.1	220.9	44.2
Punjab	39.2	41.9 †	48.4 34.0	237.1	45.8
Central Provinces	41.4	35.9 †	48.9 26.8	186.3	. .
Berār	40.8	38.4 †	50.5 31.3	219.0	. .
Madras	29.2	29.0	32.4 25.1	164.2	50.3
Bombay	34.3	34.1 †	39.0 26.9	200.4	49.3
Lower Burma	22.6	30.1	38.4 20.0	227.6	. .

* The probable true normal rates (column 6) are taken from the Report of Mr. Hardy, F.I.A., F.S.S., *Census Report*, 1891, vol. ii. The rate for all Provinces (combined) is calculated at 48.8 per mille, and this may be assumed to represent, approximately, the rates for the areas for which separate calculations have not yet been made. The subsequent decade (1891–1900) was marked by abnormal conditions arising from famine and plague.

† Famine in these areas during last quinquennium.

In spite of defective registration, the recorded rates are generally high in comparison with those of Europe, outside Germany, Austria-Hungary, and Italy: the 'probable true rates' are much higher without exception. There is great variation both in the recorded rates of different areas for the same period, and in those of different years for the same area: this is partly due to the influence of famine, and partly to differences in the registration error, the approximate measure of which is obtained by comparing the 'probable true rates' with those recorded in the non-famine period (1881–90). In Europe the average number of births per 1,000 married women at age 15–50 may be put at 250; and consequently the Indian rates (column 5) indicate defective registration or relative infertility, and doubtless both factors are in operation.

How affected by marriage customs.

We may now proceed to discuss the chief influences which determine these characteristic results. The marriage customs must undoubtedly be given a foremost place, for marriage is, in effect, not a voluntary contract as in the West, but a religious obligation, binding on both sexes, which is enforced by the social code and necessitated by the law of inheritance. Briefly, it is as a rule contracted, in the higher castes which acknowledge Brāhmanical authority, with a girl who has not arrived at puberty (though consummation is generally deferred till then), while the husband is often much older; unions are forbidden between persons of the same kindred and between those of differing castes and sub-castes; more than one wife is permitted, failing male issue by the first; widowers may remarry, but this is not permitted to widows. The results are that marriage is almost universal, at the earliest practicable age; there is disparity in the ages of husband and wife; and, as a consequence, an excessive proportion of widows. These general rules and results are subject to modification in the practice of the lower Hindu castes, Musalmāns, Buddhists, Native Christians, and some aboriginal tribes. Among them, as a rule, the age of the female at marriage is generally higher and the disparity in the ages of husband and wife is less; there is also a freer choice, from the absence of caste restrictions; and there is no restriction on widow remarriage. The following figures will afford a clearer view of the situation by comparison with Europe: it is interesting to note in passing that Hungary occupies a position, in this respect, midway between East and West.

Percentage Distribution of the Population by Civil Condition.

Age and Civil Condition.		India (1901).		Europe (excluding Hungary).	
		Male.	Female.	Male.	Female.
All ages	Unmarried	49·2	34·4	63·0	59·0
	Married	45·4	47·6	33·0	32·0
	Widowed	5·4	17·9	3·5	8·3
15—25 .	Unmarried	51·8	11·3	95·0	85·0
	Married	45·8	82·8	4·7	14·0
	Widowed	2·4	5·9	0·05	0·2
26—40 .	Unmarried	12·5	2·5	36·0	28·6
	Married	81·7	80·1	62·0	67·8
	Widowed	5·8	17·4	1·4	3·5

Among the many interesting facts to which these figures point, we may merely note the contrasts displayed in the proportions of the population married in India and Europe, and again in the proportions of the widowed and the single among males and females in India at the two age periods, denoting the earlier age at marriage of females and its penalty in widowhood. Here, then, are the conditions for a high birth-rate; but, at the same time, factors that doubtless operate to diminish the full measure of fertility which the mere marriage-rate would lead one to expect among a people the vast majority of whom are impelled by religious and social sanctions to disregard prudential considerations. The early age at marriage, with the premature strain on the immature functions, probably leads to early exhaustion in both sexes, which is perhaps hastened by the debilitating effects of malarial fevers to which all are subject; the practice of the prolonged suckling of infants may also operate. Lastly, the earliest age of procreative power is not the age of greatest fecundity.

By agricultural distress or prosperity.

But, in dealing next with the causes of the fluctuations in the birth-rate, we find influences at work of far greater and less questionable force: namely, those that affect prosperity, which, in India, is summed up for the masses in sufficient food and a relative diminution of sickness. The marriage rate is affected by the character of the harvests, as the ceremony involves lavish expenditure, loans being generally raised for which the crops are the security. But the birth-rate is a far more sensitive barometer of prosperity, because the marriage of children does not usually connote cohabitation. Nothing is

clearer than the effects of marked abundance of food or the reverse upon the general state of the public health, and of both food and health upon the birth-rate. With any marked rise or fall in food prices there is immediately a similar movement in the death-rate, and an opposite movement in the birth-rate nine months later. When famine prevails and, subsequently, other factors co-operate, marriages are deferred and the able-bodied leave their homes in search of work or relief. With the recurrence of the first bountiful harvest the tide turns, deferred marriages are celebrated, cohabitation is resumed, and the sexual instinct, depressed by privation, resumes its sway fortified by rest and by comparatively abundant food. The death-rate now falls rapidly to below the normal, owing to the previous elimination of the physically weakest; and nine months later the birth-rate (calculated on the total population, which now contains a larger proportion of persons at the reproductive ages) rises with a bound and is maintained above the normal, generally for about a year, when the ordinary relations of the rates are resumed.

By normal seasonal variations.

Similar influences may be traced in the normal seasonal incidence of the birth-rate, which is stamped with the same characteristic features in every Province, though these are subject to slight local modifications referable to the period of the harvest and of the greatest sickness and mortality. Speaking generally, where the staple food harvest is reaped in October there is a sudden rise in the birth-rate in July, continued through August to the maximum in September–October. There is a gradual fall during November–December, though the rate is still above the mean, which is reached in January; thenceforth the decline persists more or less steadily, to attain the lowest point in June. Where the staple food harvest comes in December, events are consistently postponed for about two months. The influence of the general health is manifest if the birth and death-rates are plotted together on a chart with an interval of nine or ten months between them, i.e. the death-rate for January against the birth-rate for October, and so on: the result is a striking contrast in the curves, the one falling as the other rises, though there may be occasional trifling exceptions to the rule. Again, on irrigated tracts with adequate drainage, where the crops are secure, the birth-rate is consistently high: conversely, where in water-logged areas the soil deteriorates and the people are prostrated by chronic malarial disease, there is often depopulation from impairment of fecundity.

Comparison of Hindu and Muhammadan fecundity.

Regarding the influence of race, the records only furnish particulars under local territorial distinctions: the main ethnic elements are nearly everywhere largely interfused, and any comparison between areas wherein the dominant element varies is vitiated by the registration error. Religion affords no reliable clue to ethnic distinctions. It is possible, however, to arrive at some estimate of the relative fecundity of the different races and sects by means of the Census returns of the proportion of children in each. As a rule, the aboriginal tribes and the Musalmāns (who are often proselytes from the lower Hindu castes) stand out from the general community in this respect. This is due partly to the more favourable marriage customs previously alluded to, and possibly also to the greater variety of food, which generally contains a larger measure of the animal element than among Hindus.

Proportion of male and female births.

The proportion borne by males to females at birth is shown below:—

Province.	Males born to 100 females. (Mean of 1891–1900).
Punjab	111·6
United Provinces	109·0
Bombay	108·1
Assam	107·7
Lower Burma	107·4
Berār	106·8
Bengal	106·5
Central Provinces	106·4
Madras	104·4
'Proclaimed Clans' (Infanticide Act)	106·4

The range within each area is greatest where registration, always at its worst in regard to events affecting females, is most defective. The highest proportion of males is returned in areas where the male population outnumbers the female, and where the practice of female infanticide formerly prevailed; but in certain parts of two of the Provinces at the top of the list registration is notoriously very defective, viz. in the Western Punjab and in Sind. The records of Berār, where registration is at its best, show that the excess of males born in the January to June or July period is always very much higher than during the rest of the year, the mean during a normal quinquennium being, for the first six months of the year, 107·3, and for the last six months 104·8. Now the corresponding periods of conception are April to September and October to March; and the latter period is associated with three

distinct factors—the harvest, the season of least sickness and mortality, and that of the lowest temperature, which would appear to influence favourably the relatively higher production of females[1].

The results of urban and rural conditions on the birth-rate will be gathered from the statement below:— Urban and rural birth-rates.

Province.	Ratio per 1,000 of population (Mean of 1892–6)[2].	
	Urban.	Rural.
Bengal	24·9	34·3
Assam	24·4	31·5
United Provinces	40·2	37·4
Punjab	40·4	43·8
Central Provinces	32·2	35·7
Berār	38·2	37·5
Madras	32·1	27·4
Bombay	28·5	36·4
Burma	22·3	28·6

The rates are, as a rule, lower in the towns, and lowest in the large industrial centres, owing, chiefly, to the unequal sex distribution of their population which is affected by the demand for adult male labourers—e.g. in Calcutta (1901) the proportion of males to females was as two to one, in Bombay over three to two, and in Rangoon nearly two and a half to one. The tendency to a general rise in the price of food which has marked recent times, while benefiting the agriculturist, has doubtless pressed heavily on the poorer classes in towns, where also the general standard of vitality is lower. Lastly, the women are frequently sent to their rural homes for their confinement.

The record of still-births has unfortunately not been maintained generally, but for Berār the returns give what is doubtless a fair indication of the proportion which occur in an agricultural community in India. Here, during the decade ending 1900, still-born males were at the rate of 5·2, and females of 4·1, per cent. of the live-births of the respective sexes. In the larger cities, however, the rates are far higher: in Calcutta the average for the three years ending 1900 was 8 per cent. of the live-births; in Rangoon it was 11·6 per cent.; and in Bombay the mean for 1895–9 was 12·9 per cent., rising to 18·7 in the last year. But here the rates have recently Proportion of still-births.

[1] See article 'Sex,' *Encyclopaedia Britannica*, 9th Edition.

[2] Statistics for later years furnished to the Government of India do not discriminate between urban and rural birth-rates.

been affected by the prevalence of plague and famine, which have driven mothers from and to the city in a destitute condition. The figures represent the pressure of want and insanitary conditions, and, doubtless, of barbarous midwifery; at the same time there is no guarantee that all these infants were actually born dead. The unfavourable conditions attending parturition in India ensure a high mortality of mothers and infants, but the way is open to gross neglect and, occasionally, to infanticide.

Recorded death-rates.

The introductory remarks, and the account given of marriage and the birth-rate, will have prepared the reader for some of the notable characteristics of the mortality figures. The following table affords a review of the death-rates recorded

Mortality-rates per 1,000 *in the Chief Provinces of British India*, 1881–1900.

PROVINCE.	Recorded mean for 1881–90.	Recorded mean for 1891–5.	Recorded mean for 1896–1900.	Highest and lowest rates recorded during the 20 years.	Probable true normal rate, 1888–91.	Number of years in which deaths exceed births in total period.
Bengal	22.1	30.7	30.8	36.6 / 18.8	44.8	2*
Assam	26.7	30.2	36.9	50.6 / 16.0	. .	10†
United Provinces	32.8	32.2	33.1‡	42.5 / 24.1	37.7	2
Punjab	31.3	34.5	32.4‡	49.5 / 25.2	36.0	3
Central Provinces	33.0	33.8	45.6‡	69.3 / 24.3	. .	5
Berār	33.2	38.8	48.5‡	82.7 / 23.4	. .	8
Madras	20.5	20.7	22.1	26.2 / 16.2	36.0	. .
Bombay	26.2	29.6	41.3‡	70.1 / 20.9	35.4	2
Lower Burma	17.5	20.7	26.2	27.5 / 14.7	32	. .

* During 1892–1900, births for years prior to 1892 not being available.
† During 1883–1900, " " 1883 " "
‡ Famine in these areas during this period; plague in Bengal, United Provinces, Punjab, Madras, and Bombay.

The 'probable true normal rates' are estimates based on the Census data of 1881 and 1891 by Mr. Hardy, F.I.A., F.S.S.; the rate for all British India being 39.6 per mille (see *Census Report*, 1891, vol. ii). The Assam rate is probably somewhat higher than that of Bengal, while the rates of the Central Provinces and Berār probably come between those of the United Provinces and Bengal.

in each Province during the twenty years ending with 1900, distinguishing for the second decade between the first and last quinquennia, as famine and epidemic disease, including plague, have disturbed the normal incidence of mortality in the areas noted since 1896.

Causes which affect them.

We see, first, that, in spite of defective registration, the recorded rates are, generally, very high, and exhibit a progressive rise; they are indeed much above the European standard if Austria-Hungary and Italy be excluded. They vary greatly in different areas during the same period, and in the same areas from year to year; and while this is characteristic of the figures at all times, we have to distinguish the exaggerating effects of special morbific influences, such as famine. While the progressive rise in the rates is doubtless partly due to improved registration, the inter-Provincial variations are largely the result of differences in the registration error which preclude the use of the figures for any valid comparison of the ordinary vital conditions of different areas. This is made clear if the recorded rates are compared with the 'probable true rates' (column 6); but as the local error varies inappreciably from year to year, the former afford valuable indications of the course of events in each separate area. Lastly, special attention is invited to the remarkable range of fluctuation in the Provincial rates (column 5), and to the figures showing the number of years in which the deaths have exceeded the births in each area (column 7). In all respects the greatest contrast is presented to the English statistics, and this, as we have seen, applies equally to the birth-rate: indeed, the connexion between the vital phenomena is very intimate and direct under the controlling influence of the environment, to the ordinary well-defined variations of which, every now and then, cyclical changes of a catastrophic kind are superadded. These changes, ordinary and extraordinary, are stamped upon the population, influencing its age-constitution, its vitality, and consequently its longevity and its rate of increase, with necessary reaction upon the death-rate. With a fluctuating tendency to increase during ordinary years, there are recurrent halts and local retrocessions which profoundly alter the age-constitution, by the suspension of reproductive power on the one hand, and by excessive mortality, which is most marked at certain ages, on the other. The general effects of famine in this respect have been briefly described, and some of the remarkable features of the death-rates are thus explained.

Age-statistics for India and England.

Before tracing the incidence and causes of the mortality in detail, it is necessary to glance at the age-distribution of the population, not only because it exhibits the vital material exposed to the struggle, but because it marks the effect of past vicissitudes and so affords the best corrective to the death-rates which are inaccurate as to both the numbers and the ages of the dying. The following table shows the numbers per thousand living in India at three age-periods at the Census of 1891 and of 1901, respectively, together with corresponding figures for England and Wales (1901). The influence of the intervening years of famine is shown in the diminished proportion of the under 5 population in India in 1901 as compared with 1891:—

Age-distribution of the Population, per 1,000 *living.*

	Under 5.		5—55.		55 and upwards.	
	Male.	Female.	Male.	Female.	Male.	Female.
India (1891) . .	159	162	780	771	61	67
,, (1901) . .	126	134	810	794	64	72
England and Wales	126	120	777	769	97	111

The figures for India (1891) are taken from the adjusted age-tables furnished by Mr. Hardy to the Census Report.

Mortality and expectation of life at different ages.

We may now briefly trace the incidence of mortality on age and sex, its chief causes, and their local and seasonal distribution. Any attempt to find a mean that would accurately express the resultant of all the conditions in the struggle could only have, at best, an academic interest when the irregular intervention of profoundly disturbing factors is borne in mind, factors too that operate unequally in different areas. For the present purpose it will be more useful to obtain an idea of the rates which apply to India as a whole under ordinary conditions; and, for the rest, it will suffice to apply the general considerations as to the special effect of famine and the accompanying epidemic diseases, which have been set forth. The inaccuracies in the age returns (Census) and in the registration data render the Provincial records misleading as they stand; but the former may be adjusted, and the latter corrected, in the light of certain local mortality statistics that may be deemed both representative and fairly accurate, the observed rates of increase in the population at different ages affording valuable guidance. In this way Mr. Hardy has been able to arrive at standard rates, which, though largely estimated, may be accepted as approximately accurate. For full details

of his methods and results, his valuable contributions to the Indian Census Reports of 1881 and 1891 must be consulted. The following statement, which is based thereon[1], shows the ordinary death-rates and the expectation of life at the different ages for both sexes, with the corresponding English figures for comparison :—

Age.	Estimated mortality per 1,000 living at each age-group, 1881-1891.		Mean annual death-rate, 1881-1890, per 1,000 living.		Age.	Expectation of Life at Ages in Col. 6.			
	India.		England and Wales.			India, 1881-91.		England, 1881-90.	
	M.	F.	M.	F.		M.	F.	M.	F.
Under 5	128.8	112.3	61.5	51.9	0—	24.6	25.5	43.7	47.2
5—	18.5	18.9	5.3	5.2	5—	37.1	36.1	52.7	54.9
10—	11.1	14.0	2.9	3.1	10—	35.5	34.4	49.0	51.1
15—	12.3	16.7	4.3	4.4	15—	32.3	31.7	44.5	46.5
20—	15.1	19.0	5.7	5.5	20—	29.2	29.3	40.3	42.4
25—	20.1	22.1	7.7	7.4	25—	26.3	27.0	36.3	38.5
35—	28.4	27.1	12.4	10.6	35—	21.1	22.4	28.9	31.2
45—	39.7	33.9	19.3	15.0	45—	16.5	17.9	22.1	24.0
55—	58.7	50.3	34.6	28.4	55—	12.2	13.2	15.7	17.2
65—	100.5	91.7	70.3	60.3	65—	8.2	8.7	10.3	11.3
75 and upwards	201.8	194.5	162.6	147.9	75—	4.9	5.1	6.1	6.7
All ages . .	40.6	38.6	20.2	18.0					
	39.6		19.1						

These figures are very significant as regards both the details for India and the contrast they afford to the English rates. The excess mortality in India is proportionally greatest at the 5–24 age period, when, however, the deaths represent only 14·25 per cent. of the total at all ages; the next thirty years (25–54) account for 25·5 per cent. of the total mortality; for the rest of life it is 17·7 per cent., leaving 42·6 per cent. to fall upon the 0–5 age period. The heavy loss in the working period of life is of grave import from an economic point of view, especially when the tax paid in sickness and the shorter duration of life are taken into account. It may be assumed that there are probably three cases of sickness for every death, and at this rate the number constantly sick among the 232 millions of British India would amount to nearly 28 millions. This sickness falls heavily upon the adult population, and is generally of a nature that confers no immunity, but—especially in the case of malaria, dysentery and diarrhoea, and lung diseases—rather increases the liability to subsequent

[1] The decade 1891–1901 has been ignored, owing to the abnormal conditions of famine and plague.

attacks. Where it does not temporarily prostrate, as is not infrequently the case, it often involves a lower rate of wages for labourers, and everywhere depresses the moral and physical character, and so forms a potent source of poverty. This view is enforced by the contrast between India and England in respect to the duration of life: between 15 and 35 years of age the probabilities are from 36 to 38 per cent. for males, and from 34 to 48 per cent. for females, less favourable in India: the difference at birth amounts to 79 and 85 per cent., respectively.

Male and female death-rates.

In regard to sex, while the estimated death-rates at all ages in India are 40·6 and 38·6 per mille for males and females, respectively, there is a notable contrast in the relative incidence of mortality on the 10–34 age-periods and the rest of life. This is most marked where the male population outnumbers the female—as is the case generally in the north and north-west, and notably in the Punjab and the United Provinces. During the first year of life the female death-rate is lower than the male, but the advantage gradually diminishes, to disappear at the age of 6 to 7. From this point females die off in higher proportion, the excess being greatest at 15–20, after which the difference diminishes until at age 35 it disappears, and thereafter the female rate remains lower. Here doubtless we get a broad indication of the period of procreative life, and of the special dangers that attend it owing to early marriage and the disparity of the ages of parents, to the special insanitary conditions to which the parturient woman is subjected (she being deemed 'unclean' by religious ordinance), and to barbarous midwifery. In many classes of the community the wife takes a large share of bread-winning labour, besides being the domestic drudge. There is abundant evidence of the great prevalence of puerperal fevers and convulsions, and of the frequency of 'accidents,' often induced by the meddlesome methods of native midwives. If we could assume that the difference in the male and female death-rates at the 10–34 age-periods represents the loss of maternal life in child-bed, it would indicate fully 150,000 deaths annually on the present population of British India, or about one death to every 75 live-births[1]. The Dufferin Association, by the employment of qualified lady doctors and the training of midwives, has done, and is doing, work of inestimable value in the salvation of life and in the diminution of suffering, from which, in time, other important results will follow. The statistics of

[1] In London in the seventeenth century it was about 1 to 40; in England it is now about 1 to 212.

suicide, which indicate the far greater liability of the female sex to this form of death, give, doubtless, some indication of the disabilities to which women are subject in India, among which a lack of care during illness may be included.

Starting from Ireland and progressing east and south, there is a gradual and regular rise in the mortality of infants, until in India, under ordinary circumstances, probably about one-third of those born die within the first year of life, these deaths constituting about 26 per cent. of the total mortality. The following table gives the rates per 1,000 recorded in the principal Provinces during the ten years ending 1900, with other particulars :— Infantile mortality.

Number of Infants dying out of every 1,000 *Live-births.*

PROVINCE.	Dying under 1 year of age, mean of ten years (1891–1900).		Dying under 5 years.	Rates in Famine years. Dying under 1 year.	Ordinary urban rates *. Dying under 1 year.
	Male.	Female.			
Central Provinces	294·4	273·2	434	366 (1897) 387 (1900)	345
Berār . . .	257·7	244·2	516	375 (1900)	345
Punjab . .	231·9	245·9	397	268 (1900)	264
United Provinces	230·9	228·1	378	272 (1897)	304
Lower Burma .	210·3	163·4	297	. .	277
Assam . .	206·9	205·4	351	. .	191
Bengal . .	201·6†	183·3†	319	. .	272
Bombay . .	199·0	186·4	390	266 (1900)	400
Madras . .	172·8	157·1	274	. .	198

Although the period includes years in which famine and exceptional epidemic disease prevailed in several areas, it is certain that in nearly every case the above record fails to convey an accurate measure of the loss in ordinary times. Probably this is adequately expressed by the Central Provinces rate alone, while in Madras more than one-third of the deaths are unrecorded. These Provincial rates, moreover, are the means of the District rates, which vary enormously in the same year and under apparently similar conditions. Clearly, defective registration is largely accountable, as is shown by the fact that the rates are consistently highest, and the range lowest, where registration is at its best. If, however, the results in any single area be compared with its own record, valuable indications are afforded of the general state of health and of the material resources of the people. The rates for the famine years are for the whole area calculated on the mean of the births for the

* Excluding Presidency cities and Rangoon. † Mean of 1893–1900.

year and the one preceding; but if the most severely affected tracts be taken and the calculation be based on the births of the year, the results are more portentous: e.g. in 1900 490 infants were recorded as dying out of 1,000 born in Berār; in Bombay, among a population of seven millions, the rate was 462; and in the worst-stricken areas of the Central Provinces it was over 500. Again, the urban rates (column 5) testify to the specially insanitary conditions of life in the towns, of which an approximate idea may be obtained from the rate of the United Provinces (304), for though famine increased the mortality in some of the areas, this was not the case here in the period taken (1898–1900). Lastly, in the Presidency cities and Rangoon the following rates were recorded: Calcutta 377, Madras 284, Rangoon 402, representing in all cases the means of the five years ending with 1900. In Bombay the mean rate of the twenty years ending 1895 was 421, and for 1896–1900 it was 711; but this, while marking the influence of famine and pestilence, is largely the effect of the very defective registration of births, and of fatalities among the destitute refugees brought into the city to die. The heavy mortality everywhere may be ascribed to the immaturity and ignorance of the mothers, and to the physical labour the majority are called upon to perform; to improper feeding, and to the exposure of infants to all the influences of an insanitary environment wherein the causes of malaria, small-pox, measles, bowel complaints, and tetanus abound. The practice of female infanticide, which but a few years since prevailed among certain high-caste Hindu clans, chiefly in the United Provinces, the Punjab, and Bombay, and to suppress which special laws were enacted, may now be deemed a negligible quantity in the sum of the causes in operation.

Comparison of urban and rural mortality.

The relative influence of urban and rural conditions on the mortality at all ages is a subject that invites extended reference, but it is impossible to do more here than suggest some of the main considerations. Nine-tenths of the people live from the land, the average population of an Indian village being about 360. About twenty-nine millions out of the 294 millions enumerated in 1901 occupy the towns, of which there are altogether 2,148; and of this number 1,427 towns contain less than 10,000 inhabitants, 471 between 10,000 and 20,000, while twenty-nine of the remaining 250 have a population of upwards of 100,000. There is a marked contrast in the conditions of life between the great rural majority and the town minority as regards occupation and the complex influences arising from aggregation in different

degrees. A civilization that might be justified in one case is entirely at a disadvantage in the other; and yet we find that as the original court and camp centres of the old *régime* developed into industrial towns and trade emporia, and while these grew and multiplied, there was no corresponding advance in civic organization, no adjustment to the new conditions. The circumstances were similar to those of camps, and precluded resort to the primitive methods of village conservancy, and year by year the consequences gathered fatal force. During the early period of British rule the governing power was engrossed in extending and consolidating its position, its representatives were few and scattered, and it was part of its policy to refrain from interference with the domestic concerns of the people, who have since shown themselves slow to co-operate in the development of municipal institutions. Much has been accomplished since 1870 by the provision of pure water-supplies, and of drainage and conservancy systems; but the conditions already developed have largely neutralized their effect, and the authorities of the largest cities have now to face the necessity of radical schemes of reconstruction at enormous cost. The following table affords a comparison of the urban and rural death-rates recorded in the different Provinces during the five years ending with 1900: the abnormal sex-distribution, due to an excess of adult males which is a feature of the town populations nearly everywhere save in Madras, while it tends to lower the rates, enhances their significance. It must also be pointed out that famine and plague in recent years have set up cross tides of migration, to and from the towns, which render the records in many centres especially subject to qualification.

Mean Death-rate per 1,000 *of Population* (1896–1900).

PROVINCE.	Urban.	Rural.
Bengal*	33·0	30·7
United Provinces*†	40·6	32·5
Punjab*†	35·6	32·0
Central Provinces†	50·3	45·2
Berār†	51·4	48·1
Madras	30·5	21·4
Bombay*†	61·6	38·4

The excessive proportion in towns of indoor artisans, of the poor, and of the criminal and vicious classes, doubtless involves a lower average standard of physique. But of all factors in

Over-crowding in cities: Bombay.

* Plague areas. † Famine areas.

operation, the influence of aggregation is paramount: everywhere the intimacy of the family bond, with its *ménage* in common often for three generations, entails disabilities in this connexion, but in the larger towns the dangers are greatly enhanced by economic causes. Bombay probably presents an extreme example of conditions which characterize many Indian towns, but which have no parallel in the West. The Census of 1901 discloses that 87 per cent. of all the tenements in Bombay consist of one room only, and that within these 80 per cent. of the population find shelter. In no one of the seven wards of the city is the proportion so accommodated less than 67 per cent., and in two it rises to 88. Each of these single rooms contains on an average 4·2 persons; and with this extremity of density the tenements are aggregated in huge many-storied blocks, with every arrangement, both within and on the site, calculated to defeat the access of light and air and to accumulate damp and faecal products. The conditions are such as to necessitate the constant use of artificial light during the day, and it is scarcely surprising to find that the death-rate from pulmonary phthisis for the whole city averaged 9·4 per mille during 1899 and 1900: in one ward (population 130,000) where the density is greatest, the phthisis death-rate in 1900 was reported to be 16·4 per mille. These results are confirmed by the returns of the local jail, wherein, during the three years ending 1900, 11·6 per mille of average strength died of this disease annually, the rate for London being about 1·8. The low remuneration of labour makes the problem of housing, and of the sanitary conversion of these enormous rookeries in all the large towns, one of stupendous difficulty; and the most strenuous efforts from without will fail of their full effect unless the people co-operate, and evolve a higher standard of domestic hygiene.

Hindu and Muhammadan mortality. Taking the figures for Hindus and Muhammadans under similar conditions, the death-rates are, as a rule, in favour of the latter. This is the more notable as the Musalmāns, as a body, are often included in the poorer sections of the community; they are frequently proselytes from the lower caste Hindus; and in the United Provinces they congregate more largely in the towns. Nevertheless, for the period 1891–1900 the mean death-rate of Muhammadans was lower than that of Hindus in the Punjab, the United Provinces, Madras, Bombay, and Lower Burma, and in Bengal during 1891–96. In the native army, during the five years 1895–9, the mean death-rate of Hindus (all classes) was 8·8 per mille, while that of

Muhammadans was only 3·6. Again, the available records of the mortality from plague, while subject to many qualifications, afford testimony to the greater power of resistance which Musalmāns enjoy. Lastly, the death-rate among Eurasians and Native Christians (though race cannot be invoked in the latter case) is almost everywhere invariably lower than that of the general native population. It is probable that the nature and variety of the food play a considerable part in the production of these results.

The following statement will convey a broad general idea of the distribution of the chief causes of mortality, as registered:— Causes of mortality, as registered.

Causes of Deaths recorded in all Provinces of British India.

Cause of death.	1881-90 *.			1891-1900 †.		
	Number of deaths.	Average annual death-rate per mille.	Per-centage to total deaths.	Number of deaths.	Average annual death-rate per mille.	Per-centage to total deaths.
Cholera	306,518	1·5	6·0	450,502	2·1	6·7
Small-pox	122,772	0·6	2·4	82,588	0·4	1·2
Fevers	3,359,927	16·5	66·3	4,363,055	20·0	65·5
Dysentery and diarrhoea	263,608	1·3	5·2	278,298	1·3	4·2
Injuries (snake-bite, suicide, &c.)	80,973	0·4	1·6	94,082	0·4	1·4
All other causes	934,127	4·5	18·4	1,396,936‡	6·4	21·0‡
TOTAL	5,067,925	24·8	...	6,665,461	30·6	...

The previous discussion of the death-rate makes it evident that a large proportion of the mortality is unregistered—of which perhaps 40 per cent. is referable to the deaths of infants. Next, the proportion under each registered cause to the total is, in nearly every case, misleading, notably so as regards the deaths from fevers, bowel complaints, and 'all other causes.' Premising that diseases of the lungs should have been recorded under the last of these heads, and that nearly every fatal illness in which there is a marked rise of temperature is ascribed to 'fever,' it may be affirmed generally that the actual mortality should be much more equally distributed between these three classes. This view is based on the evidence of the returns from the Native army and the jail population, of the civil

* Average population under registration, 203,778,338.
† " " 217,700,151.
‡ Includes plague.

hospital records, and of the results of special inquiries into the causes of death made by qualified practitioners in certain centres. Malarial fever is, however, doubtless a contributory in the majority of cases, either by lowering natural resistance to other diseases or by actively complicating these. The following statement shows how the recorded mortality is distributed locally, and the composition of the death-rate under ordinary conditions:—

Composition of the Death-rate per 1,000, *as registered, under Normal Conditions.*

Cause of death.	Bengal.	Assam.	United Provinces.	Punjab.	Central Provinces.	Berār.	Madras.	Bombay.	Lower Burma.	All India.
Cholera . .	2·9	3·7	2·1	0·1	1·8	2·1	1·3	1·5	1·1	2·0
Small-pox .	0·2	0·7	0·3	0·8	0·2	0·2	0·6	0·2	0·4	0·3
Fevers . .	23·3	18·0	24·9	19·5	21·2	20·1	8·1	21·5	10·7	20·3
Dysentery and diarrhoea .	5·0	3·1	1·0	0·7	1·8	6·5	0·8	1·8	1·6	1·1
All other causes	0·7	5·9	4·3	9·4	8·7	12·7	9·6	5·4	8·4	6·4
All causes .	32·1	31·4	32·6	30·5	33·7	41·6	20·4	30·4	22·2	30·1

These figures are the means of five years of a fairly normal period (1892–6), and are subject to the qualifications already indicated. The cholera rate of the United Provinces is a little higher than the normal, and for the rest it may be said that the Berār figures most nearly represent the truth. To show how the rates are modified by exceptional causes, the figures recorded in three areas recently affected by famine are subjoined.

Mortality rates per 1,000 *of Population in Famine Areas.*

PROVINCE.	Cholera.	Small-pox.	Fevers.	Dysentery and diarrhoea.	All other causes.	All causes.
Berār (1900) .	6·4	0·3	29·5	22·4	24·1	82·7
Central Provinces (1897).	6·0	0·4	41·0	8·5	13·4	69·3
Central Provinces (1900).	7·1	0·8	28·8	5·5	15·5	57·8
Bombay (1900).	8·7	0·5	28·9	11·6	20·4	70·1

This exhibits the effects of a diminished power of resistance to all disease causes, which acquired epidemic force owing to deficient and improper food, impure water, and the wanderings of the people in search of work and relief.

Three main classes of fatal disease—specific fevers, diseases affecting the abdominal organs, and lung diseases.

The ordinary causes of sickness and mortality may be said to fall mainly into three great classes. First, the specific fevers, including malaria, small-pox, influenza, Malta fever, cerebro-spinal meningitis, typhus, and doubtless others that await differentiation. Second, those affecting the abdominal organs: notably cholera and enteric fevers, dysentery and diarrhoea. Lastly, the lung diseases—tubercle, pneumonia, bronchitis, &c.; the first two being specific infections, and all frequently the *sequelae* of fevers and bowel complaints. Another fact of great significance is the wide prevalence of intestinal and skin parasites, and of ulcers and other indications of scurvy. Thus, an overwhelming proportion of the sickness and mortality is due to diseases of which the salient property is communicability; and, at the same time, there is the evidence of deficient powers of resistance, and of insanitary habits and surroundings, viz. aggregation, foul air, deficient and impure water, and defective conservancy, including drainage. Each of the three groups of disease above mentioned can be causally associated with one or more of these defects, and it will be found that the composition of the death-rate varies locally with the degree of operation of these factors. Where, as in Bengal, the chief difficulties are connected with drainage and the conservancy of the water-supplies, we see a larger proportion of malarial fevers and of bowel complaints; where, as in the Punjab, the social customs and the climate lead to crowding in ill-ventilated tenements, the other specific fevers and lung diseases are more fatal. Climate, then, operates by favouring the life processes of the micro-organic causes of disease, and by influencing the food supplies and the density of the population, and also its domestic habits, of which the most important is the degree of aggregation. Limits of space preclude an examination of the seasonal incidence of mortality in the different areas which would make this clear, and the Provincial and special reports should be consulted. Nothing could be more striking than the obvious relation which the rainfall bears to the prevalence of fevers and of bowel complaints. There is an extraordinary rise in the mortality curve from both with the establishment of the monsoon; but as dysentery and diarrhoea (and cholera is subject to the same conditions) depend chiefly on impurities washed into the water-supplies by the first deluge after drought, their maximum is reached earlier than in the case of fevers, which depend on the formation of stagnant collections of water and the causes of which require a longer period of incubation and are less quickly fatal. In the case of both fever and bowel

complaints there is a fall through the winter, with a smaller secondary rise in the hot weather, due probably to concentration of pollution of the water-supplies and to irrigation for agricultural purposes; and some of the fevers are then, possibly, of the enteric class, though malarial fevers also increase at this time. Small-pox, as in England, is more markedly prevalent in the winter, spring, and early summer, with a decided fall below the mean from July to November. Diseases of the lungs are most fatal during the rains and in the winter months, when, in addition to vicissitudes of climate, the people are crowded in their dwellings.

Epidemics. The circumstances under which excessive mortality from epidemics occurs have been generally indicated in the previous pages; and relapsing fever, dengue, and plague have to be added to the list of the specific fevers in this connexion. They are the results of some marked change in the relations of the aggregate of individuals to the environment, or of some exaggeration of the force of one or more of the factors. Failure of the rains, by diminishing the food-supply, has an immense and immediate effect on the vital powers of the population, lowering its resistance to all ordinary and extraordinary causes of mortality, while facilitating their propagation. On the other hand there is the danger of excess of rainfall; of cyclonic storms; of inundations from overflow of rivers, to which both the drier and the wetter tracts are subject. More gradual, but persistently fatal, are the results, in the shape of epidemic fevers, of the geographical transformations incident to the building up of land in deltaic areas, involving floods and alterations in the courses of rivers and of the natural drainage. The effects of aggregation vary with the conditions: on the one hand, an outbreak of cholera or small-pox among a concourse of pilgrims; on the other, the more gradual evolution of conditions that invite the ravages of plague and typhus.

Small-pox. The record of small-pox is very imperfect for the first seventy years of the nineteenth century: inoculation was widely practised and vaccination only made its way slowly against the prejudices of the people. The number of operations in India in 1850 did not exceed 350,000, but since then the quality and quantity of the work have steadily increased, the number of persons now annually protected exceeding eight millions. The figures below are interesting, and there is little doubt of the diagnosis of this disease, with which the most ignorant are familiar. The figures show a decrease in the

mortality, account being taken of the growth of population, which represents the saving of about 1,160,000 lives in the third period as compared with the first, although, owing to plague and famine, all the conditions, save vaccination, were more favourable to the disease in 1890–1900.

SMALL-POX MORTALITY IN BRITISH INDIA.			VACCINATION.
Period.	Annual average number of deaths.	Ratio per 1,000 of population.	Annual average number of persons successfully vaccinated.
1871–80 . . .	168,964	0·93	3,951,709
1881–90 . . .	121,680	0·63	5,024,352
1891–1900 . .	81,233	0·38	6,778,624

For an account of the present plague epidemic the reader must be referred to the official reports, and especially to that of the Indian Commission of 1898–9. Since the recognition of the outbreak in Bombay in August, 1896, it has appeared in epidemic form in six of the Provinces of British India, and in several of the Native States. The aggregate number of deaths from plague recorded up to the end of 1903 amounted to 2,105,548, distributed, in round numbers, as follows: Bombay, including Sind, 934,000; Punjab, 454,000; Bengal, 178,000; United Provinces, 129,000; Central Provinces, 43,000; Madras, 30,000; Central India, 30,000; Mysore, 88,000; Hyderābād, 44,000; Kashmīr, 10,000; Rājputāna, 3,000. The record of deaths for Bombay city for the same period is 113,129, and for Calcutta 34,769[1]. Plague.

The European army in India provides a select population of adult males (with a smaller number of women and children), aliens to the country and climate, and subject to the vicissitudes of war. The Native army consists of the pick of the manhood of the various indigenous races, also liable to war risks and to service outside their original habitat, a change to which most natives are peculiarly sensitive; while the majority of the prisoners represent the destitute and vicious sections of the general population. All these classes have been under daily medical observation for many years, the records of which possess a substantial scientific value, and there is also a large mass of literature dealing with many of the problems of public health. To these detailed sources of information, the most important of which are indicated in the Bibliography Vital statistics of troops and prisoners.

[1] For further information about plague, see Vol. IV, ch. xiv.

at the end of this chapter, we must refer the reader who would pursue the investigation of the many questions that arise out of the bare statement of the main facts, which is all that space admits of here. In regard to the brief historical review presented, it must be noted that the sanitary awakening in England, though heralded by a few army and navy surgeons at the end of the eighteenth century, may be dated from the middle of the nineteenth century. After the first Public Health Act (1848), there was little progress until the question of army sanitary reform engaged the attention of Royal Commissions in England (1858) and in India (1863), with important legislative results in both countries. A Sanitary Department was organized in India in 1864; but many medical officers had already been calling attention to defaults in the hygiene of the troops and prisoners, and considerable progress in amelioration had been made before the Indian Commission was appointed. The movement was therefore roughly synchronous with that in England.

European army.

The first table below shows the gross death-rates among European troops per mille of strength for periods commencing roughly with the term of office of the first Governor-General and ending with the Mutiny; and the table which follows, which also gives the rates per mille, affords some idea of the chief causes of mortality. It must be remembered, however, that during these periods wars were much more frequent than has been the case subsequently.

Period.	Presidency Army.			All India.
	Bengal.	Bombay.	Madras.	
1770–1800	70.6	78.2	37.5	54.7
1801–30	80.6	95.4	84.3	84.6
1831–56	69.6	50.4	47.3	57.7

Presidency Army.	Period.	Fevers.	Dysentery and diarrhoea.	Cholera.	Hepatitis.	Phthisis pulmonalis.	Other diseases.	All causes.
Bengal	1812–31	29.7	19.3	8.5	4.3	2.6	11.5	75.9
	1832–52	13.6	14.3	10.4	4.0	1.8	20.0	64.1
Bombay	1803–27	10.8	19.9	5.4	4.2	1.6	22.7	65.6
	1828–53	10.6	12.8	10.0	4.1	1.4	11.7	50.7
Madras	1829–38	4.8	13.3	7.4	5.2	*	14.3	45.0
	1841–52	2.8	8.0	6.4	2.9	*	11.9	32.0

* Not available.

The extent of the sickness may be gathered from the fact that, during the whole period, the men were admitted to hospital at the rate of over 2,000 per mille of strength, while the loss by invaliding amounted to 29 per mille. The Royal Commission of 1863 expressed the opinion that a death-rate of 20 per mille might 'be taken as the possible mortality under improved sanitary conditions,' and the record of the first twenty years of what may be termed the sanitary era will show how soon their anticipations were to be more than realized :—

Sickness and Mortality per 1,000 *among the European Troops in India*, 1870–89.

Period.	Admissions to hospital (all causes).	Deaths from						In-valid-ing.
		Cholera.	Enteric fever.	Other fevers*.	Hepa-titis.	Dysentery and diarrhoea.	All causes.	
1870–9	1,475	3·2	2·0	1·4	2·1	1·6	19·3	43
1880–9	1,493	1·7	3·7	0·9	1·4	1·2	15·7	27

That is to say, an average death-rate of about 70 per mille during the first half of the century had been reduced to an average of 17·5, which is equal to a saving of over 100,000 lives on the average strength in the last thirty years. The following figures show the position during the six years ending with 1900 :—

Sickness and Mortality per 1,000 *among the European Troops in India*, 1895–1900.

Constantly sick.		Cholera.	Enteric fever.	Other fevers *.	Tubercle of lungs.	Other respiratory diseases.	Hepatic inflammation and abscess.	Dysentery and diarrhoea.	Venereal diseases.	All causes.
87	A	0·9	26·5	368·0	3·9	29·0	20·4	55·0	419·0	1,360·0
	D	0·6	7·0	0·7	0·5	0·6	1·3	1·1	0·2	16·7

A = Admissions to hospital; D = Deaths.

If field operations be excluded, the death-rate for India falls to 15·6 per mille. Out of every thousand men, 30 were invalided annually, but of these only 10·6 for discharge from

* Including intermittent, remittent, and simple continued.

the service. The following statement shows how the liability to sickness and mortality is affected by age and length of foreign service:—

Sickness and Mortality per 1,000 *by Age and Length of Service among the European Troops in India* (1895–9)[1].

AGE.	Admitted to hospital (all causes).	Admitted for enteric fever.	Deaths from all causes.	Deaths from enteric fever.	Invalided (all causes).
Under 20	1,064	24·0	9·2	5·1	15·3
20—25	1,703	38·6	18·1	10·2	37·9
25—30	1,200	14·9	11·8	3·9	27·8
30—35	620	6·5	13·4	2·4	21·0
35—40	553	2·1	15·6	1·4	27·6
40 and upwards	545	. .	26·7	. .	48·7
LENGTH OF SERVICE IN INDIA.					
Under 1 year	1,693	62·8	23·2	15·1	24·5
1—2 years	1,524	31·7	16·3	8·5	39·0
2—3 "	1,414	20·6	13·5	5·7	35·1
3—4 "	1,315	15·9	11·6	4·9	35·0
4—5 "	1,239	13·6	11·1	4·2	31·6
5—10 "	1,244	9·9	14·1	2·8	29·1

The marked effect of enteric fever on the relative age incidence of mortality will be noted. Lastly, more than half the total invaliding is due to four classes of disease: namely, venereal diseases, 23 per cent.; intermittent and remittent fevers, 11; diseases of the heart and circulation, 11; and debility, 9 per cent.

Officers of the European army.

The mortality among officers of the Company's service during the period 1814–33 is stated to have been at the rate of 38 per mille of strength per annum, and that for officers of the Royal Army in India, 34 per mille: the contrast afforded by the figures for the six years ending with 1900, in which it fell to 14·4 per mille, is striking and instructive. The chief causes of mortality are similar to those affecting the troops, though there is a lower fatality under each head save cholera.

Women of the European army.

The early records of sickness and mortality among the women connected with the European army are scanty and unreliable; but in the Bengal army the average annual death-rate for the four years before the Mutiny was 44·5 per mille, and this rose to 49 6 during the four years following. It fell to an average (for India) of 24·5 per mille during the first decade of the sanitary

[1] In 1900, as in 1901, the statistics are affected by the abnormal ages of the troops, due to absence of reliefs owing to the South African War.

era, and the present improved conditions are shown by the fact that in 1895–1900 it was only 16·6 per mille.

Children of the European army.

The average annual death-rate among European soldiers' children in the Bengal army during the four years prior to the Mutiny was 84·1 per mille, and it rose to 93·3 in the decade ending 1870, the mortality from cholera accounting for 11·2 of the total. The effect of sanitary measures is perceptible in the decrease to 67·8 per mille (for India) in 1871–80, and to 44·4 for the six years ending with 1900. Of the mortality of recent years 94 per cent. occurs within the first five years of life: the average death-rate for the first year is 195 per mille, and for the 0–5 age-period 71, or about 15 more than that in England and Wales. Measles and whooping cough caused annually 50 cases of sickness among every 1,000 children, and diphtheria and croup accounted for 25 deaths in the six years ending 1900, a rate of 0·74 per annum.

Native army.

It is impossible to obtain an accurate measure of the sickness and mortality of the Native troops in the past, for the records take no account of that occurring among the men who were absent from their regiments on leave. While some general idea may be obtained from the following statement, which mainly corresponds to the second quarter of the nineteenth century, it may be said that the true gross death-rate probably amounted then to at least 22 per mille :—

Presidency Army.	Period 1833–53*. Ratios per mille of strength of deaths from				
	Cholera.	Dysentery and diarrhoea.	Phthisis.	Fevers.	All causes.
Bengal . .	1·81	1·6	0·22	5·1	14·4
Bombay .	2·29	1·9	0·45	5·5	15·8
Madras . .	7·34	2·1	. .	2·8	18·8
All India .	2·9	1·8	0·22	4·8	15·6

Passing over the next twenty-five years, the records for which are similarly vitiated but indicate little change in the conditions, we come to the first decade of the sanitary era (1871–80), when the admissions to hospital averaged 1,287 per mille of strength, and the death-rate 20·3[1], while 34 men in every thousand were

* Period 1842–52 for Madras.

[1] This period, it must be remembered, covers the Afghān War.

invalided for discharge. We may now examine the position in 1895–1900, as set forth in the following table:—

Sickness and Mortality per 1,000 *in the Native Army of India* (1895–1900).

Constantly sick.		Cholera.	Fevers: intermittent, remittent, and simple continued.	Tubercle of lungs.	Other respiratory diseases.	Dysentery and diarrhoea.	Venereal diseases.	All causes.
30	A	1·5	327·9	3·0	43·6	58·7	37·5	782·9
	D	0·9	1·8	0·7	4·0	0·7	0·1	11·7

A = Admissions to hospital; D = Deaths.

To this, which shows a reduction in the mortality of nearly 50 per cent., equal to an annual saving of over 1,200 lives, it may be added that the invaliding rate has fallen to 13 per mille of strength. Enteric fever caused only 204 admissions and 67 deaths during the six years, yielding ratios of 0·3 and 0·09 per mille per annum, respectively: that is to say, the European troops are about 88 times more liable to this disease, from which the mortality to strength is nearly 80 times greater, than are the troops of the Native army.

Jail population. The following statement exhibits (per 1,000) the general character of the jail mortuary statistics during a period which corresponds roughly to the second quarter of the nineteenth century:—

Prisoners in the Jails of Presidencies.	Period.	Admissions to hospital (all causes).	Deaths from				
			Fevers.	Dysentery and diarrhoea.	Cholera.	Pulmonary phthisis.	All causes.
Bengal .	1833–54	1,235	10·9	21·7	8·7	1·3	72·5
Bombay .	1831–53	1,281	13·1	15·0	10·9	0·7	61·5
Madras .	1844–53	1,050	4·4	17·0	15·1	2·6	61·3
India . .		1,230	10·8	20·7	9·3	1·3	70·7

During the next seventeen years there was little improvement. The death-rate for Bengal averaged 68·2 per mille, but in Bombay it fell to 44·2, while in Madras it rose to 78·5 owing chiefly to outbreaks of cholera. This brings us to the year 1870, the commencement of the sanitary era and of the appointment of medical officers to the full administrative charge of jails. During 1871–80 the average death-rate in Bengal was 46·6 per mille, and in Bombay 53·7. In Madras it was still as

high as 73·9, but two-thirds of the mortality occurred in famine years (1877–8). If this period be excluded, the Madras rate falls to 36 per mille, and the combined rate for all India to 46·4. We may now examine in detail the record of the twenty years ending with 1900, and in order to convey an idea of the present position, the figures for 1881–94 and 1895–1900 are given separately. In the latter period they are deduced from an average annual strength, for all India, of 112,951 prisoners.

Sickness and Mortality per 1,000 *among Prisoners in India*, 1881–1900.

Province.		Sickness.		Deaths from					
		Average constantly sick.	Admissions to hospital (all causes).	Fevers *.	Cholera.	Dysentery and diarrhoea.	Phthisis pulmonalis.	Other respiratory diseases.	All causes.
Bengal	1881–94	45	1,324	3·3	5·0	19·2	3·4	5·4	45·9
	1895–00	38	1,088	2·8	2·3	9·4	3·7	4·3	29·6
Assam	1881–94	55	1,836	3·5	5·3	20·4	0·8	5·6	48·9
	1895–00	51	1,008	9·0	4·2	15·6	1·6	4·4	47·7
United Provinces	1881–94	31	757	1·4	1·5	7·2	1·8	5·9	25·6
	1895–00	46	888	1·7	0·4	8·5	2·6	5·8	27·9†
Punjab	1881–94	36	1,486	3·0	1·6	8·0	1·5	11·3	33·2
	1895–00	34	1,279	1·1	0·1	3·9	2·6	6·1	20·0
Central Provinces.	1881–94	32	930	2·1	4·4	20·1	0·8	5·6	46·3
	1895–00	43	1,049	1·9	3·4	38·6	3·9	6·7	71·4†
Bombay	1881–94	27	766	2·9	1·7	7·2	1·1	9·1	32·2
	1895–00	29	806	2·6	2·9	6·8	2·8	7·6	33·4†
Madras	1881–94	27	739	1·0	4·4	10·4	1·5	3·0	30·9
	1895–00	26	661	1·8	4·6	4·2	3·3	2·9	26·9
Berār	1881–94	19	688	1·5	0·6	2·4	1·1	4·7	17·0
	1895–00	19	672	1·3	1·6	8·7	1·5	7·9	34·2†
Burma	1881–94	41	955	2·1	6·9	10·8	2·6	3·4	38·3
	1895–00	31	672	1·1	1·8	4·9	3·7	2·4	20·0
Andamans.	1881–94	62	1,745	3·9	..	9·1	3·3	5·1	31·7
	1895–00	51	1,682	3·6	..	12·3	5·0	3·2	32·1
All India	1881–94	38	1,099	2·4	2·8	10·7	2·1	6·1	33·8
	1895–00	39	996	2·1	1·5	9·1	3·2	5·0	29·6

* Under 'fevers' are grouped 'intermittent,' 'remittent,' 'simple continued' and 'enteric' fevers, the death ratio of 2·15 (1895–1900—all India) being made up thus: intermittent 0·95, remittent 1·05, simple continued 0·04, and enteric 0·11. Intermittent fevers cause four times as many admissions as remittent and half as many again as simple continued: there were only 168 cases of enteric in all the jails during the six years period.

† Famine in 1896–7 and in 1900.

This shows a reduction in the combined death-rate (India) of nearly 60 per cent. compared with the period up to 1870. It must be noted, too, that during 1895–1900 famine and exceptional epidemic disease prevailed in at least five of the Provinces, and affected the population in nearly all, driving to crime large numbers of the destitute, many of whom were admitted to jail in the last stages of disease and want. In the three years 1901–3 the death-rates for all India have fallen to 26·8, 24·8, and 21·4 per mille respectively.

It is calculated that under normal conditions the death-rate of the free population between the ages of 20 and 64 is about 29 per mille, so that the present jail death-rate affords testimony to the care and skill bestowed on the prisoners, who are for the most part drawn from the poorest and most depraved sections of the community. As regards the causes of mortality, it will be seen that the proportion borne to the total by the sum of the four classes of disease distinguished in the table on page 530 is 54 per cent. in the last period (1895–1900), against 59 per cent. in the first (1833–53). There has, therefore, been little or no change in the nature and type of the chief disease causes; but the death-rate from cholera has decreased by 7·8 per mille, that from fevers by 8·7, that from dysentery by 11·6, or by about 28 per mille under the three heads, while the phthisis rate has increased by 1·9, owing doubtless to improved diagnosis. The death-rate from small-pox (1895–1900) was only 0·07 per mille.

Comparison of European and Native troops and prisoners as regards disease statistics.

Finally, it will be instructive to compare the incidence of the chief causes of sickness and mortality on the three classes hitherto discussed (European and Native troops and prisoners), taking the mean results for the five years 1895–9.

In every 100 admissions to hospital there were among:—

European Troops.	Cases.	Native Troops.	Cases.	Prisoners.	Cases.
Venereal diseases	31·2	Intermittent fever	38·3	Intermittent fever	34·2
Intermittent fever	22·6	Dysentery .	5·9	Dysentery .	9·9
Simple continued fever	2·4	Venereal diseases	4·6	Abscess, ulcer, and boils	9·1
Dysentery . .	2·3	Respiratory diseases *	3·6	Diarrhoea .	6·1
Respiratory diseases *	1·8	Remittent fever	2·1	Respiratory diseases *	3·6
				Simple continued fever	2·3

* Excluding tubercle and pneumonia.

In every 100 deaths there were among :—

EUROPEAN TROOPS.	Cases.	NATIVE TROOPS.	Cases.	PRISONERS.	Cases.
Enteric fever .	43·4	Pneumonia .	31·6	Dysentery . .	24·2
Hepatic abscess .	8·1	Remittent fever .	9·9	Pneumonia .	14·1
Dysentery . .	6·3	Tubercle of lungs	6·0	Tubercle of lungs	11·1
Heat-stroke .	4·8	Intermittent fever	5·3	Diarrhoea . .	7·0
Pneumonia . .	3·7	Cholera . .	4·4	Anaemia and debility	5·7
Tubercle of lungs	3·5	Respiratory diseases *	4·4	Cholera . . .	4·1
Circulatory diseases	3·0	Dysentery . .	4·3	Respiratory diseases * . .	3·6
				Remittent fever.	3·6
				Intermittent fever	3·4

As regards sickness, the Europeans are specially liable to a class of disorder from which the natives under comparison are much freer, owing largely to marriage or incarceration. In regard to the mortality, we see the pre-eminent fatality of specific bowel and lung diseases, though its relative measure varies with the circumstances, including the susceptibility and vitality of the subjects. The disabilities of the class from which the prisoners are drawn have been alluded to; those of the Native troops are largely due to exposure to strange climates, not necessarily outside India, and to their freedom to indulge their ingrained domestic customs in barracks. If it were not for enteric fever, the probabilities of life for the European troops would be as good as for males at the same ages in England; but the subject is too extensive and intricate for discussion here, and is dealt with at length in the reports about to be mentioned. The prospects of a further diminution of the present comparatively low death-rate lie chiefly in the direction of the prevention of this disease, and that it will be achieved to a large extent admits of little doubt.

Cholera statistics of troops and prisoners in Bengal.

The following statement of the sickness and mortality (per 1,000) from cholera among the troops and prisoners in Bengal, the 'home' of the disease, may fitly close this brief review, as it affords a significant summary of the results of the application of sanitary measures to which the foregoing pages bear ample testimony :—

* Excluding tubercle and pneumonia.

PERIOD.	European Troops.		PERIOD.	Native Troops.		PERIOD.	Prisoners.	
	Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.
1818–27 .	29·8	8·8	1831–53	8·3	3·0*	1833–54	20·5	8·8
1828–37 .	33·7	8·0						
1838–47 .	32·2	13·0						
1848–57 .	20·0	9·2						
			1861–70	5·0	2·5*	1859–70	21·8	8·9
1858–67 .	15·1	9·1						
1870–4 .	4·1	2·6	1870–4	2·0	1·1	1870–4	7·0	2·8
1875–9 .	5·4	3·8	1875–9	2·8	1·6	1875–9	8·8	4·3
1880–4 .	3·3	2·3	1880–4	1·1	0·7	1880–4	4·0	2·2
1885–9 .	2·2	1·4	1885–9	1·7	1·1	1885–9	6·2	3·6
1890–4 .	2·7	1·9	1890–4	2·6	1·6	1890–4	3·7	2·1
1895–1900	1·5	1·1	1895–1900	1·3	0·9	1895–1900	4·1	2·3

These figures refer to communities over the physical conditions of which the Government and its officers exercise more or less control, though the troops live among, and come into constant contact with, the general population. Moreover, there are conditions inalienable from the concentration of large bodies of men in barracks or jails which enhance the difficulties of excluding sickness of a communicable nature. The results prior and subsequent to the sanitary era may be contrasted; and it should be noted that the period 1895–1900 is one in which cholera among the general population was, owing to famine and scarcity, prevalent beyond all previous record.

A. E. ROBERTS.

* Cases and deaths among those absent from their regiments not included before 1870.

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(*b*) Medical and charitable relief—the annual Provincial Reports (6) on Vaccination, from 1861-9 to date, the year of commencement varying in different Provinces; (7) on Hospitals and Dispensaries, from 1852-76 to date; (8) the several Famine Reports, notably those of the Commissions of 1880 and 1901.

(*c*) The Special Reports on Epidemic Disease in India are very numerous, and only the main sources will be cited as they contain the necessary references. For cholera, (9) the Reports of the Presidency Boards on the great epidemic of 1817, and that of the Commission of 1861; (10) the Statistical Record of Cholera in Bengal from 1817 to 1872, by Bryden (1874); the Sanitary Reports (2) and (3) *supra* bring the record up to the present date, the volumes of (2) for 1878 and 1894 being specially valuable. For epidemic malarial fever, in Bengal and Assam, see early volumes of (3) for Bengal, and (11) the Reports of Elliott (1863); Giles (1890); Rogers (1897); Ross (1899).

For Plague, (12) Report of Indian Commission of 1898-9 (1901).

Army.—(13) Report of the Royal Commission on the Sanitary Condition of the Army in India (1863); (14) Bryden's Statistical Tables (Bengal) from 1858 to 1870—the Sanitary Reports (2) bring the record up to date; (15) Army Medical Department Reports, 1859 to date.

Prisoners.—See (14) and (2); (16) the Annual Reports of the Inspectors-General of Jails from 1850-66 to date; (17) Reports of the Jail Committees of 1838, 1864, 1877, and 1889.

NOTE.—Nos. (2) and (3) and many of the official reports quoted may be obtained in London from Messrs. Arnold, Constable, Sampson Low, and other publishers; in Berlin, from Messrs. Friedländer; in Paris, from Messrs. Leroux.

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